NORTHLAND

DOWNTOWN

MAJOR INVESTMENT STUDY

Preferred Strategy Report
Index

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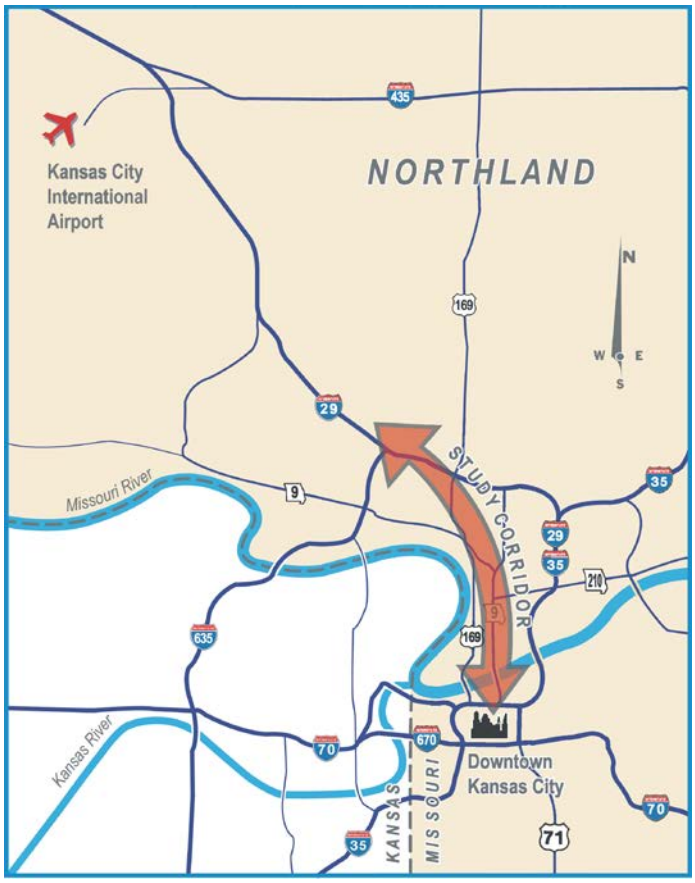
Summary

September, 2002

Northland and Downtown Connections

Kansas City's Northland is an area realizing its tremendous growth potential. In recent years, this growth has accelerated. Separated from the rest of Kansas City by the natural barrier created by the Missouri River, connectivity to Kansas City's urban core is critical to the long-term vitality of the Northland. FOCUS, Kansas City's comprehensive land use plan, highlights the importance of maintaining close ties between the Northland and Downtown and recommends, "improvement of physical connections across the river with dedicated transit lanes and corridors and improved signage."



Study Corridor Map

Recognizing the critical nature of the connections between the Northland and Downtown, and in an effort to address the growing mobility problems across the river, a multi-agency team combined with citizen input recently completed a major investment study of transportation linkages across the river. This study focused on connections to Downtown, but also considered travel demands between Downtown and the Kansas City International Airport economic activity center. Today, this travel market is predominately served by I-29 and US 169 which radiate from Downtown. For the purposes of this study, Downtown is defined as the Central Business District generally bounded by the Downtown freeway loop. The Study Area is defined as the area surrounding I-29, US 169 and other facilities that currently serve the KCI to Downtown travel market. This includes the three downtown Missouri River roadway bridges – Broadway (US 169), Heart of America (Route 9) and Paseo (I-29/I-35).

Paseo Bridge

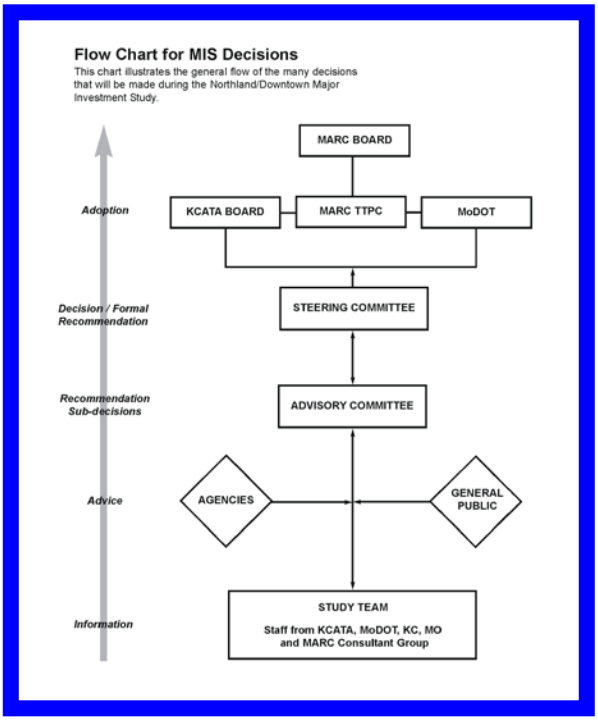
Heart of America Bridge

Broadway Bridge

Study Process

In the spring of 1998, the Missouri Department of Transportation and the Kansas City Area Transportation Authority funded and initiated the Northland~Downtown Major Investment Study. Contributing also to the study was the City of Kansas City, Missouri and the Mid-America Regional Council. This partnership of agencies oversaw and managed the study. The study was conducted by a team of consultants led by a joint venture of HNTB and Parsons Brinkerhoff.

The Northland~Downtown MIS convened two committees to guide the study's proceedings and to ensure that the area's local and regional concerns were addressed – an Advisory Committee and a Steering Committee. Comprised of community leaders and transportation experts, these committees met numerous times during the course of the study to guide the study process. Critical steps where committee input was integral to the decision-making process included: study goals and objectives; community plan development; problem definition; initial improvement concept definitions and evaluations; definition and evaluation of more detailed strategies; and the preferred strategy recommendation. The committees reviewed findings of the technical analyses, including travel demand forecasts, cost estimates and route studies.



In January 2002, following the recommendation of the Steering and Advisory Committees, the Total Transportation Policy Committee of MARC approved the preferred strategy recommendation for adoption into the region's updated long-range transportation plan.

Community Involvement

A Community Involvement Plan was established at the outset of the Northland~Downtown MIS. The Plan was created using information gathered through a working session of the study team, community interviews, and analysis of existing opinion research. The plan served as a blueprint for guiding activities to inform and involve the public.

The goals of the Community Involvement Plan included:

- Identify key individuals and groups and recognize their concerns.
- Effectively inform and involve all stakeholders.
- Build support for the study's recommendations.

The Plan included a list of activities to establish two way communications with the public and study team. Tools used to establish these communications included mailings, project telephone and mail box, a logo, an audio-visual presentation, a newsletter, community briefings, public meetings, media relations, and the Steering and Advisory Committees. Highlights of the Plan's execution include:

- A mailing list was established with names and addresses compiled from the Northland business, civic and elected officials.
- A dedicated mailing address and a project phone number were set up to answer questions specific to the MIS.
- A logo was created to provide an immediate association to the Northland~Downtown MIS and the cross-river aspects of the study.
- Numerous community presentations were held throughout the project.
- A public meeting was held on Thursday, November 19, 1998, at the Line Creek Elementary School. Basic information included background information; summary of the Study Area problems; initial ideas for solutions; description of the decision-making process, and comment/input process.
    - Fifteen meetings of the Steering and Advisory Committees were held. These committees were comprised of 110 individuals who met on a continuing basis to receive new information and guide the study process.

Study Goals and Objectives

MARC's established regional transportation goals and objectives, along with FOCUS and other adopted goals of the sponsoring agencies, collectively provided the basis for the assessment of the Study Area's existing and future transportation-related problems. The goals and objectives framework for this MIS focused on these regional issues. The effectiveness of the existing and planned transportation system in accomplishing these goals determined the extent of the need for transportation improvements. Similarly, the effectiveness of the transportation solutions in accomplishing these goals and relieving the problems was a consideration in the assessment of the potential solutions.

Goals	Objectives
System Preservation	• Maintain and/or prolong the useful life of existing elements of the street, highway, and transit system.
Personal Mobility and Quality of Life	• Serve all viable travel modes. • Consider alternatives to Single Occupancy Vehicles (SOV). • Assure improvements in the efficiency and effectiveness of transit. • Provide greater access to the transit system. • Enhance transportation connections across the Missouri River, between downtown Kansas City and the Northland. • Improve east-west mobility. • Maximize opportunity for low income persons to access jobs. • Provide connections for non-motorized modes of transportation, such as bicycle and pedestrian facilities. • Assure maximum possible accessibility for persons with disabilities. • Seek to maintain or improve environmental quality and encourage the efficient use of energy and natural resources. • Protect sensitive natural resources such as stream corridors, floodplains, woodlands, and steep slopes. • Maintain or improve air quality.
Safety	• Promote and implement transportation system investments that minimize the occurrence and severity of accidents. • Increase security in transit systems and safety of all users, regardless of mode.
Land Use and Development	• Encourage redevelopment of existing areas, new development contiguous to existing development, mixed use development and development at higher densities. • Promote neighborhood identity in the Northland and enhance the physical connections between the neighborhoods. • Promote development of the Northland within the context of the FOCUS plan. • Promote pedestrian-friendly development patterns. • Promote development patterns and land use characteristics which decrease the need to travel and encourage the use of alternative transportation forms.
Regional Economy	• Assure coordination of improvements with development patterns. • Enhance the region's position as an intermodal center for national and international freight shipment and as a hub for intermodal passenger transportation. • Provide improved transportation connections between regional activity centers, designed to accommodate expansion. • Seek local government official actions to integrate development with proposed transportation investments.
System Management and Efficiency	• Provide for all regionally significant roadways to operate at or above level of service "D" and other modes of transportation to operate at acceptable standards.
Cost Effectiveness	• Demonstrate that the overall benefits of the improvements warrant their costs. • Ensure the improvements are financially feasible. • Distribute costs and benefits of the improvements in an equitable manner.

Problem Definition

Many of the basic problems experienced in the corridor, both today and in the future, are a reflection of the corridor's commuter-oriented travel demands. In this case, the travel markets show three different travel patterns affecting the performance of the system:

- Trips between the Study Area and Downtown.
- Trips between the Study Area and places south of Downtown.
- Trips within the Northland.

The growth in travel across the Missouri River will be significant. Consequently, current congestion and mobility problems on the Downtown bridges will continue to worsen in the future. Between 1990 and 2020, total daily trips across the river are expected to increase by 42% -- an annual compound growth rate of slightly over 1%.

By knowing the root causes of the basic problems experienced in the transportation system, planners can more readily identify appropriate solutions. Observations gained from the market analyses relevant to potential solutions include the following:

- There is a defined and growing travel market to the urban core from the Northland. The travel demands associated with this market lead to the congestion problems crossing the Missouri River. ***Solutions that provide improved travel capacity between the Northland and the urban core would relieve the river crossing's existing and future mobility problems***.

- Daily travel across the Missouri River is growing. Cross-river trips destined for areas outside of the urban core, which must travel through the downtown area due to the limitations of the existing infrastructure, contribute to the congestion across the river in the downtown area. ***Solutions that address the mixture of cross-river trips destined to areas inside or outside of the urban core would mitigate the river crossings' capacity problems in the downtown area.***

- With the business and development growth potential of the area, travel within the Northland itself is anticipated to grow significantly. The Northland's east-west mobility problems, which have been documented in earlier planning studies, reflect this desire for internal Northland travel. Primarily, existing north-south corridors accommodate this intra-Northland travel, creating inefficiencies and out-of-direction travel. These problems will continue to worsen as Northland travel increases. ***Solutions to downtown-oriented commuter problems will also need to better serve shorter intra-Northland travel.***

Basic Problems (Symptoms)

The transportation-related problems currently experienced or projected within the Study Area are symptoms of several basic issues specific to the Northland:

- **Changing Travel Markets** – Cross-river travel destined for locations outside the Northland~Downtown MIS Study Area.
- **Increased Intra-Northland Travel** – Short trips using/affecting the highway system.
- **Aging and Outdated Transportation Infrastructure** – River bridges, poor pavement, obsolete design.
- **Limited Non-Highway Mobility Options** – Transit, bicycle, pedestrian.
- **Land Use and Development Patterns** – Decentralized development patterns, dependence on the automobile and jurisdictional issues.
- **Traffic Congestion** – Increasing congestion crossing the Missouri River.
- **Inefficient Use of Transportation System** – Need for better traffic-flow management.

General Findings of the Study

A broad range of possible solutions was explored to solve the transportation-related problems within the Study Area. Through a process of exploring the benefits and impacts of these possible solutions, the committees made numerous important findings. These findings helped guide the study process and were influential in the ultimate study recommendation:

- ***Study Horizon*** – While the Study Area extended to KCI, the committees agreed early in the process, based on the findings of the system operational analysis, that major investments in highway capacity and transit improvements north of the I-29/US 169 Interchange area are not required within the 2020 horizon.

- ***Limits of Study Scope*** – While there is a long-standing concern over complex transportation problems and needs throughout the entire Northland, the committees recognized the difficulty of trying to answer all Northland issues in a single study. The committees accepted the limitation that this study would focus on the travel corridor between KCI and Downtown.

- ***River Crossing Focus*** – The committees recognized and accepted the magnitude and complexity of north-south and east-west travel issues within the Study Area, and agreed with the study scope which focused on the river crossing issues.

- ***Relationship with Central Business Corridor Transit Planning*** – After the MIS had been underway for some time, the separate Central Business Corridor Fixed Guideway Study south of the River required close coordination and integration with this study. This resulted in a specific light rail recommendation for the Northland that was integrated directly into the CBC Study recommendations. The CBC Study recommendations were included in an August, 2001 sales tax election in Kansas City, which was defeated. Consequently, the transit recommendations for this MIS do not specify the technology to be utilized, but do recognize the need for subsequent coordination of the Northland transit with any subsequent transit improvements within the CBC.

- ***Downtown Loop*** – During the MIS, it became clear that the highway and bridge improvements over the Missouri River could worsen existing travel conditions in and around the Downtown freeway loop. The improvements over the River could be expanded to more comprehensively address the problems within the Loop as a whole, and help accomplish the land use goals for Downtown. As a result, the City of Kansas City and MARC joined MoDOT and KCATA to expand the study scope to include Downtown land use and travel analyses.

Study Recommendation

The best improvement strategy for better transportation system linkage across the Missouri River was selected following an evaluation of various strategies. The evaluation took into account each strategy's effectiveness in accomplishing the goals of the study. To address all these goals, a combination of inter-modal transportation improvements is recommended:

Travel Markets
Technical Memorandum

August, 1998

1.0 Introduction

This technical memorandum presents the findings of travel characteristics, patterns, and markets of the Northland~Downtown MIS. This analysis or trip origins and destinations provides insights into the current and future transportation problems in the study area, and into the alternatives that might address these problems.

2.0 Methodology

Three levels of analysis were performed using 1990 and 2020 person trip and work trip tables supplied by MARC. In level 1, the metropolitan area was divided into two transportation analysis areas, one north and one south of the Missouri River. Productions and attractions in each of the two areas were reviewed to assess changes in the amount of travel in the Northland and changes in travel across the river.

For Level 2, the metropolitan area was subdivided into 15 districts as shown in Figure 1. The Level 2 analysis looked at the following four travel markets:

- Person trips produced in the four Platte City districts – Platte County South (District 4), Platte County North (District 5), Platte County East (District 11), and Platte County West/KCI (District 12).
- Person trips attracted to each of these four districts.
- Work trips attracted to downtown Kansas City.
- Other work trips crossing the Missouri River.

The 15 by 15 matrices used in the Level 2 analysis are provided in the Appendix.

The Level 3 analysis divided Platte County East (District 11) into western and eastern Subdistricts (11a and 11b), using I-29 as a dividing line. This analysis looked at total person trips produced in and attracted to Subdistricts 11a and 11b to see if there are significant differences in travel produced in or attracted to the two sides of I-29.

The results of all three levels of analysis are presented in production/attraction format. In production/attraction format, a person who travels from District A to District B, and back to District A, is considered to have taken two trips, both of which were produced in District A, where the travel originated and both of which were attracted to District B.

3.0 Level 1 Findings

Figures 2 and 3 present the results of the Level 1 analysis. The numbers in the circular boxes represent the number of trips originating in that area, with the top number indicating the trip productions in 1990 and the bottom number trip the expected trip productions in 2020. The arrows show where these trips go, either to destinations north or south of the Missouri River. The numbers in parentheses indicate the share of all trips going to that destination. In summary:

- In 1990, 77% of the person trips produced north of the Missouri River were attracted to destinations in the Northland, while 98% of the trips produced south of the river stayed south of the river (see Figure 2).

- Total travel across the river is projected to grow more than 40% more than 40% between 1990 and 2020 (Figure 2). The number of person trips produced in the Northland and attracted to destinations south of the river is projected to grow from 161,7000 to 235,500 per day, an increase of 46%. The number of daily person trips produced south of the river and attracted to the Northland is projected to grow from 92,500 to 124,500, an increase of 35%.

- The number of work trips crossing the river is projected to increase as well (Figure 3). Work trips from the Northland to jobs south of the river expected to grow 35% from 71,800 to 98,000 per day. Work trips from south of the river to Northland jobs are projected to increase from 38,400 to 56,800 per day, or 48%.

- In 1190, 54% of the work trips produced north of the river went to destinations south of the river, while 6% of the work trips from south of the river went to destinations north of the river (Figure 3). The share of work trips that stay within the Northland is expected to increase from 46% to 56% over the study period.

4.0 Level 2 Findings

Figures 4 through 7 illustrate the destination of all trips produced in the four Platte County districts. As in previous figures, the top number represents 1990 trips and the bottom number represents 2020 trips. Shading has been added to these figures to show the share of trips attracted to a particular district in 2020 – the darker shading corresponds to a higher percentage of all trips. Significant findings from the analysis of trip productions are:

- In 1990, Platte County South (District 4) produced more trips (122,000 per day) than the other Platte County districts combined. The other three districts each produced less than 30,000 trips per day.

- The number of trips produced in all four districts is expected to grow significantly. Trips produced in Platte County South (District 4) are projected to grow by 70%, from 122,000 to 207,400 trips per day, between 1990 and 2020 (Figure 4). The amount of travel produced in Platte County East (District 11) is expected to grow by over 300%, from 26,400 to 117,200 trips per day (Figure 6). Platte County North and Platte County West/KCI (Districts 5 and 12) will also experience significant growth in travel, but the number of trips produced in these districts will remain at 30,000 per day or

less (Figure 5 and 7).

- Short trips make up a significant part of all Northland travel, and will represent a larger share of all trips by 2020. In Platte County (District 4), 26% of all trips stayed within the district in 1990. That percentage is expected to grow to 30% in 2020. In Platte County East (District 11), 16% of all trips stayed within the district in 1990, and that is expected to grow to 28% by 2020. In absolute terms, intra-district travel in Platte County East (District 11) is projected to grow eight-fold, from 4,300 to almost 33,000 trips per day.

- Other significant destinations for trips produced in Platte County South are Clay County West (District 7) and Platte County East (District 11). Each of these districts attracted more than 10% of the trips from Platte County South in 1990. The share of Platte County South trips going to these two districts is expected to exceed 15% by 2020. In 1990, Clay County South (District 8); Wyandotte, Johnson and Leavenworth Counties in Kansas (District 3); and the Kansas City CBD each attracted 5% to 10% of the trips produced in Platte County South. The percentage of Platte County South trips destined for these three districts is expected to slightly decline by 2020.

- Significant destinations for trips produced in Platte County East (District 11) are Platte County South (District 4) and Clay County West (District 7). Each of these districts attracted more than 20% of the trips produced in Platte County East in 1990. These shares are expected to remain relatively stable even as the number of trips produced in Platte County East grows four-fold over the study period. In 1990, five districts including the Kansas City CBD each attracted 4% to 7% of the trips produced in Platte County East. The number of trips from Platte County East to these five districts is expected to grow by 2020, but the percentage of trips going to these districts is expected to decline.

Figures 8 through 11 illustrate the person trips attracted to the four Platte County districts. Significant findings are:

- Platte County (District 4) is expected to attract 173,600 person trips by 202, an increase of 101,400 (140%) compared with 1990. Some 30% of this growth will be intradistrict trips. Platte County East (District 11) and Clay County West (District 7) also produce a large portion of the trips going to Platte County South, and produce a large portion of the increase over the1990 to 2020 period (Figure 8).

- Platte County East (District 11) will attract 124,000 trips by 2020, an increase of 76,500 (160%). Intra-district trips account for 37% of this growth. Other significant producers of trips and new trips to Platte County East are Platte County South (District 4) and Clay County West (District 7) (Figure 10).

- Travel to Platte County West/KCI (District 12) is expected to double, reaching 28,000 by 2020. Most of these new trips will originate within Platte County. A significant number of trips to Platte County West/KCI are also produced in Wyandotte, Johnson and Leavenworth Counties in Kansas (District 3) (Figure 11).

Figure 12 illustrates work travel to downtown Kansas City.

- Of the 121,600 daily work trips attracted to the CBD in 1990, about 6400 (5%) were produced in the four Platte County districts. Clay County West (District 7) produced 6100 (5%) of CBD work trips, and Clay County Southwest (District 9) produced 1800 (1%).

- Between 1990 and 2020, the number of work trips from all eight Northland districts to the CBD is expected to grow from 24,000 to 29,100, or 21%. This increase will represent about 19% of the 26,200 new north to south work trips that are expected to cross the river in 2020.

Figure 13 shows the district pairs that are expected to contribute most significantly to the growth in cross-river work travel. As illustrated, much of the growth represents suburb-to-suburb commutes. The largest increases will occur between Platte County South and East (Districts 4 and 11) and Wyandotte, Johnson and Leavenworth Counties (District 3), and from Independence and Jackson County East (District 14) to Clay County South (District 8).

5.0 Level 3 Findings

Platte County East (District 11) was divided into two parts, Subdistricts 11a and 11b, using I-29 as the dividing line. Travel that is expected to be produced in and attracted to the two subdistricts in the year 2020 was analyzed to identify any significant differences between the two sides of I-29. Tables showing the results can be found in the Appendix.

This analysis found that:

Of the 117,000 trips produced in Platte County East (District 11) 49,235 (42%) produced west of I-29 and 68,000 (58%) are produced east of I-29. The destinations for these trips are generally very similar, with the following exceptions:

- There is a very substantial amount of travel between Subdistrict 11a (west of I-29) and 11b (east of I-29).

- Of the trips produced in District 11 and attracted to Clay County West (District 7), a disproportionately high percentage originate west of I-29 in Subdistrict 11a.

- Of the trips produced in District 11 and attracted to Platte County North (District 5), a disproportionately high percentage are produced east of I-29 in Subdistrict 11b.

Some 124,000 trips attracted to Platte County East (District 11), of which 79,000 (64%) have destinations on the west side of I-29 and the balance have destinations on the east. The origins for these trips are similar except as noted below:

- As noted above, the travel between Subdistricts 11a and 11b is very substantial.

- Of the 15,000 daily trips coming to District 11 from Platte County North (District 5) and Platte County West/KCI (District 12), a disproportionately high percentage are attracted to Subdistrict 11b.

- Of the 3000 daily trips coming to District 11 from Independence and Jackson County East (District 4) and from Johnson and Jackson County South (District 15), a disproportionately high percentage are attracted to Subdistrict 11a.

6.0 Conclusions

Travel to, from, and within the Northland is expected to grow significantly between now and 2020. Most of this growth will consist of relatively short trips within the Northland. East-west (non-radial) travel is expected to increase more rapidly than north-south or radial travel. Given the predominant land use patterns, it may be assumed that the vast majority of these new trips will be made on the highway system. Improvements to the Interstate system may benefit these travelers. However, improvements to the arterial street system, including east-west roadways crossing the Interstate, would probably serve many travelers more directly, and could help to preserve Interstate capacity for long distance travel.

The growth in travel across the Missouri River is far less dramatic than the growth in travel within the Northland, but this growth is still significant. Much of the increased work travel across the river is expected to occur in circumferential patterns – between Platte and Wyandotte Counties, and from eastern Jackson County to Clay County. This new cross-river travel is likely to utilize the I-635 and the I-435 bridges, which are outside the Northland~Downtown Corridor. The growth in travel over the Broadway, Heart of America, and Paseo Bridges is expected to be less significant.

The Northland~Downtown MIS is concerned with north-south travel within the western part of the Northland. The study will consider potential improvements to the corridor's major north-south facilities leading to and from downtown Kansas City. A significant part of Northland travel is outside the scope of this study, and the study will not be able to provide definitive answers to all of the Northland's travel problems.

Transit and Roadway Cost Estimate Technical Memorandum

May, 2001

1.0 Introduction

Capital and operating costs were developed for both the Initial Strategies (Phase 1) and the more detailed Alternative Strategies (Phase 2) in the Northland~Downtown MIS. Cost estimates were developed for roadway and transit modes. The following technical memorandum presents a summary of the order-of-magnitude cost estimates. Cost estimates are also shown in the *Evaluation of Initial Strategies Technical Memorandum* and the *Preferred Strategy Technical Memorandum*.

2.0 Methodology

Capital cost estimates and operating/maintenance cost estimates were prepared to support decision-making in both Phase 1 and Phase 2 of the MIS. Capital costs include all physical construction costs, as well as utility relocation, vehicle procurement, right-of-way and engineering costs. Operating and maintenance (O&M) costs represent the annual costs in the study's horizon year of 2020. The capital and operating/maintenance cost estimates for Phase I are presented in 1999 dollars and Phase II are presented in 2001 dollars.

The Northland~Downtown MIS is a planning study, and as such there are many uncertainties as to the details of any potential improvement. The primary uncertainties are a reflection of the range of design options and their consequent impacts on right-of-way, displacements, mitigation, traffic management, etc. A range of operating options exist for the transit alternatives – service frequency, technology, train lengths, fare collection policies, etc. Due to these uncertainties, a contingency factor of 20 percent has been added to the roadway improvements to represent unforeseen costs and design uncertainties. For transit, a range of estimates was developed in Phase 1 and contingency factors of 20 to 25 percent were applied in Phase 2. A "project reserve" was also included in the capital cost estimate for fixed guideway transit.

2.1 Initial Strategies (Phase 1)

In Phase 1 order-of-magnitude cost estimates were developed for the preliminary roadway and transit alternatives. Cost estimates were developed for each initial strategy and were used to help decision-makers select the strategies to carry forward to Phase 2.

Transit

For capital costs, a "low end estimate" and a "high end estimate" were developed for Bus Rapid Transit, Light Rail, and Commuter Rail between downtown Kansas City and KCI on different alignments. These conceptual "order-of-magnitude" estimates took into account the length of the system in various configurations (aerial, at grade, open cut), vehicle and systems requirements, and the number of stations. Unit cost assumptions were based on the actual cost of similar systems elsewhere in North America. The estimates included percentage add-ons for utilities, environmental mitigation, design, construction management, and other factors.

Preliminary estimates of operating and maintenance (O&M) costs were also developed in Phase 1. Such costs include the cost of labor to operate and maintain the vehicles, as well as fuel or power for propulsion.

Roadway

Cost estimates were developed in Phase 1 for roadway improvements by reviewing Missouri Department of Transportation (MoDOT), District 4 bid tab data. Once generalized unit costs were developed, they were applied to initial strategies to arrive at an order-of-magnitude roadway capital cost estimate.

2.2 Analysis of Alternative Strategies (Phase 2)

Phase 2 costs estimates were based on more detailed engineering of the six roadway and transit strategies selected for further analysis and evaluation. While more detailed, the Phase 2 engineering was still at a conceptual level and left many design and operational details for consideration in later studies and project development. Cost estimates were developed for each alternative and were used to help decision-makers identify a preferred strategy.

Transit

The capital cost estimate for Fixed Guideway Transit assumed the use of standard light rail technology as it has been utilized in other North American cities. A double-tracked First Stage system would operate from downtown Kansas City to a temporary terminus in the vicinity of the North Oak Transitway and I-29. The assumed alignment includes a new transit bridge across the Missouri River, and follows Burlington and the North Oak Transitway. The alignment is further described the *Transit Fixed Guideway Route Studies Technical Memorandum*. Trains were assumed to operate at 12-minute headways in the peak period.

The five-mile line was divided into six segments for capital cost estimating purposes. The cost estimate for each segment was built up from estimates of guideway, trackwork, site modifications, utilities, stations, support systems, systems, and additional items. The cost of vehicles, right-of-way, environmental mitigation, and contingencies and other add-ons was estimated for the entire 5-mile route and was added to the build up of segment costs. Unit costs were derived from the actual construction costs of other North American light rail systems, and were coordinated with the cost estimates being prepared concurrently by others for the CBC Study.

Low cost transit improvements were assumed to be included in all of the strategies except for the Base Condition. A capital cost estimate for these improvements was built up from its

component parts – bus purchases, bus maintenance facility, park-and-ride facilities – and includes add-ons for contingencies, engineering and management.

The O&M cost estimate for the alternative transit strategies in the Northland was based on separate calculations for fixed guideway transit and the ATA bus network. The O&M estimate for fixed guideway transit assumed light rail technology and was derived from the O&M estimate prepared in the Central Business Corridor (CBC) Study. The CBC estimate was based upon a cost model that reflects the estimated number of annual revenue car miles. For the Base Condition and the Low Cost Improvements strategy, the cost of operating and maintaining LRT north of the Missouri River was subtracted from the CBC estimate of system-wide O&M costs for LRT.

To estimate the O&M cost of KCATA bus services, a cost model was developed based on the ATA's current cost of service. The three-factor model included the number of buses required to operate the service in peak periods, annual vehicle miles, and annual vehicle hours. The assumed level of bus service was not equilibrated to reflect the forecasted ridership on each route. Further studies of bus routes, headways and ridership would be necessary to identify the most efficient bus service operating plan for the Northland and system-wide.

The unit costs and the cost estimates for the transit elements of the various improvement strategies were reviewed by the KCATA and were coordinated with the CBD study.

Roadway

In Phase 2, more detailed roadway cost estimates of the capital cost and operations and maintenance of each alternative were developed. The estimate included the construction of physical facilities, right-of-way acquisition and relocation, utility relocation, environmental mitigation, and allowances for engineering, maintenance of traffic and contingencies. Build-up tables were developed for roadway cross-sections. Using the build-up cost tables, a unit cost table was developed. MoDOT reviewed the unit cost tables.

Operations and maintenance cost estimates were developed by reviewing MoDOT O&M costs for District 4. A unit value of $6,519 per annual lane mile was assumed. This number represents all costs to operate the District 4 office minus construction and right-of-way costs.

3.0 Cost Estimates

3.1 Transit

Table 1 presents the capital cost estimates developed in Phase 2 of the MIS. As shown, the bus service improvements included in all of the alternatives (other than the Base Condition) are expected to cost $37 to $38 million. Those strategies that include the first stage of a fixed guideway transit system (assumed to be LRT for cost estimating purposes) are estimated to cost about $210 million more than those strategies that rely on improved bus service alone. Unit cost tables and quantities for light rail transit is shown in Appendix B.

Table 1
Opinion of Probable Transit Capital Cost
(Million 2001 Dollars)

	Base Condition	Low Cost	Partial Roadway	HOV	Low Cost with 1st Stage Fixed Guideway	Partial Roadway with 1st Stage Fixed Guideway
	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F
Bus Components:						
Bus Purchases		$15.5	$15.5		$14.5	$14.5
Bus Maintenance Facility		$10.0	$10.0	Capital Cost Not Estimated	$10.0	$10.0
Park-and-Ride		$1.0	$1.0		$1.0	$1.0
Contingency		$5.9	$5.9		$5.7	$5.7
Engineering and Management		$6.0	$6.0		$5.9	$5.9
Subtotal		**$38.3**	**$38.3**		**$37.0**	**$37.0**
LRT Components:						
Construction					$109.0	$109.0
Right of Way					$2.8	$2.8
Vehicles				Capital Cost Not Estimated	$11.5	$11.5
Contingency					$31.0	$31.0
Engineering and Management					$43.1	$43.1
Reserve					$11.8	$11.8
Subtotal					**$209.3**	**$209.3**
Total Capital Cost (Rounded)	**$0**	**$38**	**$38**		**$246**	**$246**

The annual transit O&M cost estimated for each strategy is presented in Table 2. With a substantial increase in transit service compared with today, all of the strategies would increase O&M costs above current levels. (In 1999, the cost of operating ATA bus service was $52.3 million.) The bus and rail services in the Base Condition would have an O&M cost of nearly $100 million per year. The Low Cost and First Stage Fixed Guideway strategies for the Northland would increase O&M costs by an additional $16 to $18 million per year. The strategies that include a First Stage Fixed Guideway system are shown to cost slightly more than those that rely on improved bus service alone. As noted above, the O&M costs for all strategies might be reduced through an equilibration effort to match the assumed level of bus service with projected ridership.

To some degree, the increase in transit O&M costs would be offset by increases in transit fares, as improved service leads to higher ridership. The percentage of O&M costs covered by fares is referred to as the farebox recovery ratio. In 1999, the KCATA had a farebox recovery ratio of 15.5%. If transit were to be significantly expanded in the Northland, additional state and/or local funding would be required to cover the capital cost and that part of the increased O&M cost that could not be met out of the farebox.

Table 2
Opinion of Probable Transit Operations and Maintenance Cost
(Million 2001 Dollars)

	Base Condition	Low Cost	Partial Roadway	HOV	Low Cost with 1st Stage Fixed Guideway	Partial Roadway with 1st Stage Fixed Guideway
	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F
Bus Components:						
Peak Vehicles	338	400	400		396	396
Annual Revenue Miles (million)	1.22	1.47	1.47		1.44	1.44
Annual Revenue Hours (million)	0.89	1.07	1.07		1.05	1.05
Bus O&M Costs (million per year)	$85.9	$102.6	$102.6	O&M Cost Not Estimated	$101.1	$101.1
LRT Components:						
Annual LRT Train Miles (million)	0.92	0.92	0.92		1.13	1.13
LRT O&M Costs (million per year)	$12.8	$12.8	$12.8		$16.0	$16.0
Totals:						
Annual Vehicle Miles (million)	2.14	2.39	2.39		2.57	2.57
O&M Cost	$98.7	$115.4	$115.4		$117.1	$117.1
Additional O&M Costs	$0.0	$16.7	$16.7	-	$18.4	$18.4

3.2 Roadway

Cost estimates calculated in Phase 1 are shown in the *Initial Strategies Evaluation Technical Memorandum*. Roadway improvement costs estimates are presented for each Phase 2 alternative. Roadway improvements are organized by interchange and roadway segments, as shown in Table 3.

Cost estimates are shown for Low Cost (Alternative B) and for Partial Roadway (Alternative C) roadway alternatives. They are also included in the transit/roadway combination alternatives. A cost estimate was not developed for HOV (Alternative D) since this alternative was proven not to be a viable alternative (see *High Occupancy Vehicle Strategy Fatal Technical Memorandum*).

Table 3
Opinion of Probable Roadway Capital and Operations and Maintenance Cost
(Million 2001 Dollars)

	Base Condition	Low Cost	Partial Roadway	HOV	Low Cost with 1st Stage Fixed Guideway	Partial Roadway with 1st Stage Fixed Guideway
	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F
Interchanges						
US 169 (Broadway) / 5th & 6th Street Interchange		23.6	$25.0		23.6	$25.0
I-29 / Tiffany Springs Parkway Interchange		8.8	$8.8	Construction Cost Not Estimated	8.8	$8.8
I-29 / Armour Road (HWY 210) Interchange		$19.7	$19.7		$19.7	$19.7
I-29 / North Oak - Vivion Road Interchange		$11.5	$11.5		$11.5	$11.5
I-29 / US 169 Interchange		$16.3	$17.3		$16.3	$17.3
Roadway Segments						
Northeast Downtown Loop to Front Street			$38.3			$38.3
Front Street to Armour Road (HWY 210)			$126.3	Construction Cost Not Estimated		$126.3
Armour Road (HWY 210) to Russell-Parvin Road			$14.7			$14.7
Russell-Parvin Road to US 169			$39.7			$39.7
Total Capital Cost (Rounded)	**$0**	**$80**	**$301**		**$80**	**$301**
Total O&M Cost (Rounded)	**$0.00**	**$0.03**	**$0.19**		**$0.03**	**$0.19**

Note: Total construction cost includes engineering, demolition, construction and inspection

As shown in Table 3, the Low Cost (Alternative B) roadway improvement is estimated to have a capital cost of $80 million and the Partial Roadway (Alternative C) is estimated to cost $301 million. This wide range of roadway capital costs is directly related to the degree of roadway improvements. Unit cost tables and quantities for both the Low Cost and Partial Roadway Alternatives are shown in Appendix A.

3.3 Downtown Loop

Downtown loop analysis identified cost estimates for four loop scenarios defined in detail in the *Downtown Land Use and Freeway Loop Technical Memorandum.* A summary definition of each alternative analyzed is as follows:

- **Modified Base Scenario** – Existing loop configuration with Alternative F improvements.
- **Design Concept No. 1, Partial One-Way Loop** – Converting the west and east legs of the Downtown Loop to one-way freeway operations.
- **Design Concept No. 2, Full One-Way Loop** – Converting the full Downtown Loop to one-way freeway operations.
- **Design Concept No. 3, North Boulevard Scenario** – Converting the north leg of the Downtown Loop to an arterial parkway with at-grade intersections and/or possibly a traffic circle.

Cost estimates shown in Table 4 represent Phase 1 level of detail. An order-of-magnitude cost range is presented, representing the large number of uncertainties. Two roadway improvement components are shown in the table, which include new access directly from I-29 to the central business district's street network and improvements to the freeway loop surrounding the central business district.

Table 4
Downtown Loop Roadway Improvements
(Million 2001 Dollars)

	Modified Base Scenario	Partial One-Way Scenario	Full One-Way Scenario	North Blvd. Scenario
Planning-Level Construction Cost Estimates				
- Access Enhancement for I-29 Widening	$30M to $60M	$30M to $60M	$30M to $60M	$30M to $60M
- Loop Scenario Improvements	$270M to $370M	$430M to $640M	$430M to $650M	$550M to $760M

Transit and Highway Travel Demand Technical Memorandum

May, 2001

1.0 Introduction

The purpose of this technical memorandum is to provide summary information about the travel demand model results for both highway and transit modes. Forecasted travel demand data was generated for a 2020 design year. Six unique and competing improvement alternatives were analyzed which include:

- **Alternative A - Base Condition:** No-Build Transit, No-Build Highway
- **Alternative B - Low Cost:** Expanded Bus, Low-Cost Highway (Interchange Improvements such as Broadway and 5th/6th Street)
- **Alternative C - Partial Roadway:** Expanded Bus, Partial Roadway (Capacity Improvements along I-29 plus Interchange Improvements)
- **Alternative D - HOV:** Expanded Bus, HOV Lane
- **Alternative E - Low Cost with 1st Stage Fixed Guideway:** LRT to I-29, Low-Cost Highway (Interchange Improvements such as Broadway and 5th/6th Street)
- **Alternative E (KCI Option) - Low Cost with 2nd Stage Fixed Guideway:** LRT to KCI, Low-Cost Highway (Interchange Improvements such as Broadway and 5th/6th Street)
- **Alternative F - Partial Roadway with 1st Stage Fixed Guideway:** LRT to I-29, Partial Roadway (Capacity Improvements along I-29 plus Interchange Improvements)

Travel demand forecasting has been one of the key technical activities in the Northland~Downtown MIS. For each of the alternatives, the forecasting process estimates the number of trips that would utilize transit and the number of trips that would be made on the highway system. The forecasting process also estimates demand on individual links of the highway and transit systems.

The results of this analysis can be used as a primary indicator of each alternative's transportation benefits. The demand forecasts for transit, for example, provide a good indication of how well each alternative serves the mobility needs of corridor residents. Transit ridership may also be indicative of other potential benefits, such as reduced highway congestion, air pollutant emissions, and energy consumption.

2.0 Travel Demand Forecasting Methodology

The Kansas City regional travel demand model was used to forecast year 2020 traveler demand for each alternative. The regional model encompasses the greater Kansas City metropolitan area, over 2,000 square miles. Inputs to the model include:

- The regional network of major roadways and bus/rail lines assumed for each alternative,
- Parking costs and transit fares, and
- Predictions of 2020 population, households and employment, which were supplied by the Mid-America Regional Council (MARC).

Development and calibration of the model was based on empirical surveys carried out over the past 10 years. Therefore, the model results are based on observed traveler behavior in the Kansas City region.

The Base Condition network assumes that a number of committed and planned roadway and transit projects will be in place by 2020. Some of these projects include Choteau Bridge improvement, I-35 Commuter Rail, and that portion of the Central Business Corridor Transit Plan that lies south of the Missouri River.

3.0 Transit Results

The results of the transit demand analysis are presented in Table 1.

The table provides ridership estimates for “linked trips” and “unlinked trips”. A typical commuter who takes transit from home to work in the morning, and back home again in the evening, is considered to have made two “linked trips” – one from home to work and the second from work to home. “Unlinked trips” refers to the number of times a transit vehicle is boarded. Thus, if a commuter takes a feeder bus and transfers to light rail in the morning, and in the evening takes light rail and another feeder bus back home, that person has made four “unlinked trips”, but only two “linked trips”.

Significant findings are:

- The No Build Alternative is expected to attract about 5200 linked transit trips per day in the Northland – about 3500 more trips than in 1995.
- All of the transit improvement alternatives – expanded bus, expanded bus on HOV lanes, and light rail transit – are projected to attract more transit riders than the No Build Alternative. The alternatives with HOV and LRT attract the most riders.
- A LRT line across the river to North Oak and I-29 would carry approximately 3000 passengers per day in 2020. Regional rail ridership would grow from 13,000 in the Base Condition to 16,000 passengers per day.
- Extending light rail from North Oak and I-29 to KCI would increase LRT ridership in the Northland to 4,400 trips per day, and to 17,600 systemwide.
- Increasing highway capacity with the Partial Roadway improvements has minimal impact on transit ridership.

Table 1
Summary of Transit Demand Results
(Year 2020)

	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E (KCI Option)	Alt. F
LRT Ridership (Corridor)	0	0	0	0	3,000	4,400	3,000
LRT Ridership (System)	12,900	12,900	12,900	13,000	16,000	17,600	16,000
Total Unlinked Transit Trips (Corridor)	5,800	7,300	7,300	9,300	11,100	11,900	11,100
Total Unlinked Transit Trips (System)	81,400	83,300	83,300	86,300	87,200	88,200	87,200
Total Linked Transit Trips (Corridor)	5,200	6,100	6,100	7,500	7,600	8,700	7,500
Total Linked Transit Trips (System)	57,100	57,900	58,000	59,800	59,600	60,800	59,600
Change in Linked Trips (Corridor, vs. No Build) i.e. New Riders	NA	900	900	2,300	2,400	3,500	2,300
Change in Linked Trips (Corridor, vs. Exp. Bus) i.e. New Riders	NA	NA	0	1,400	1,500	2,600	1,400

Notes:

1. Corridor represents trips crossing the River on the three Study Area bridges (Broadway, Heart of America and Paseo).
2. System represents the entire metropolitan area trips.

4.0 Highway Results

Highway travel demand data from the model went through a post processing step to develop adjusted model results. This step was necessary to adjust raw model output to better replicate existing and future travel conditions. Travel demand model results across the Missouri River are shown in Table 2.

Table 2
Daily Vehicle Travel Demand Crossing the Missouri River
(Year 2020)

	Year	2020 Design Year Alternatives						
	1998	A	B	C	D	E	E[1]	F
Screenline 1 Total of 3 River Bridges	168,000	212,000	211,000	211,000	212,000	210,000	209,000	210,000
Broadway Bridge	45,000	70,000	70,000	55,000	64,000	78,000	78,000	62,000
Heart of America Bridge	34,000	48,000	48,000	38,000	44,000	39,000	38,000	30,000
Paseo Bridge	89,000	94,000	93,000	118,000	104,000	93,000	93,000	118,000
All Other River Bridges[2]	210,000	367,000	367,000	367,000	366,000	367,000	367,000	367,000
Total All Bridges	378,000	579,000	578,000	578,000	578,000	577,000	576,000	577,000

1 KCI Option
2 Other River bridges outside the Study Area include: SR 92 (Leavenworth), I-435 (west), I-635, Chouteau, I-435 (east), and SR 291.

- There is virtually no difference in the total number of vehicles that cross the Missouri River for each of the alternatives at the three Downtown-oriented bridges.

- Compared to the No-Build Alternative, the Partial Roadway Alternative is expected to generate a 21% decrease in traffic demand within the US 169/Route 9 corridor pair and a 25% increase in traffic demand within the I-29/I-35 corridor. A 100% increase in roadway capacity, across the Missouri River, in the I-29/I-35 corridor allows for the increase in traffic demand to occur, while providing a good level of service that would not otherwise be realized.

- There would be relatively little change in traffic demand for all other River bridge crossings outside of the Downtown-oriented bridge crossings as a result of any of the alternative improvements.

- The Partial Roadway Alternative increased the total demand on I-29 by 35% (34,518) daily vehicles over the other alternatives just north of the I-29/I-35 split. A select link analysis at this location indicates a heavy east/west movement in the Northland. More than half the trips are east/west. This result confirms earlier market study analysis.

- There is little difference in the total number of vehicles between each alternative north of the I-29/US 169 split. The total change in traffic demand between the Partial Roadway Alternative and the No-Build constituted only a 1% change.

5.0 High Occupancy Vehicle (HOV) Analysis

High occupancy vehicle lanes were analyzed using the travel demand model. The travel demand model identified the number of vehicles that would use the HOV facility that were destined for the CBD in the southbound direction during the AM peak hour.

HOV Section	Southbound AM Peak Demand
I-635 to US 169	191 vehicles
US 169 to I-29/I-35 split	402 vehicles
I-29/I-35 split to CBD	618 vehicles

These vehicles could expect a travel time savings of 9.6 minutes compared to the No-Build and 2.9 minutes compared to the Partial Roadway Alternative from the northern terminus to the CBD. Since the MARC model does not estimate the number of new carpools that might be formed as a result of these time savings, this forecast of HOV facility usage is likely to be low.

6.0 Regional MOE Summary

Regional measures of effectiveness (MOE) of daily 2020 vehicle miles traveled (VMT) and vehicle hours traveled (VHT) were generated from the model. Each alternative is compared to Alternative A – No Build condition in Table 3.

As shown in the table:

- On a regional basis the differences in VMT, VHT, and average speed are very small – on the order of 1% or less – and are well within the range of error in the estimate.

- When Alternative B (Low Cost Improvements) is compared to the No-Build, regional travel increases on the freeways and decreases on arterial roadways. The conversion of auto trips to transit also leads to fewer vehicles on the arterial roadways. VHT increases are a result of the conversion of auto trips to transit trips and the longer travel time of these trips. The low cost interchange improvements in this alternative provide isolated interchange operational improvements rather than system operational benefits. The overall change in vehicle hours traveled is relatively small.

- When Alternative C (Partial Roadway Improvements) is added to the No-Build, freeway travel increases as the freeway becomes more attractive for motorists. A decrease in arterial travel, as a result of more freeway travel, creates an overall decrease in distance traveled on all roadways as well as a decrease in travel time. This is a result of motorists being able to use a more direct freeway travel route than a more circuitous one made on the arterial network. The change in vehicle hours traveled is more substantial than shown in Alternative B.

- When Alternative E (Low Cost Improvements Plus LRT) is added to the No-Build, the LRT converts auto trips to transit trips thus providing a reduction in freeway travel distance and travel time, but not to the same extent as Alternative C. This translates

to an overall improvement in travel distance and travel time to all roadways with fewer vehicles on the roadway than Alternative B (Low Cost Improvements).

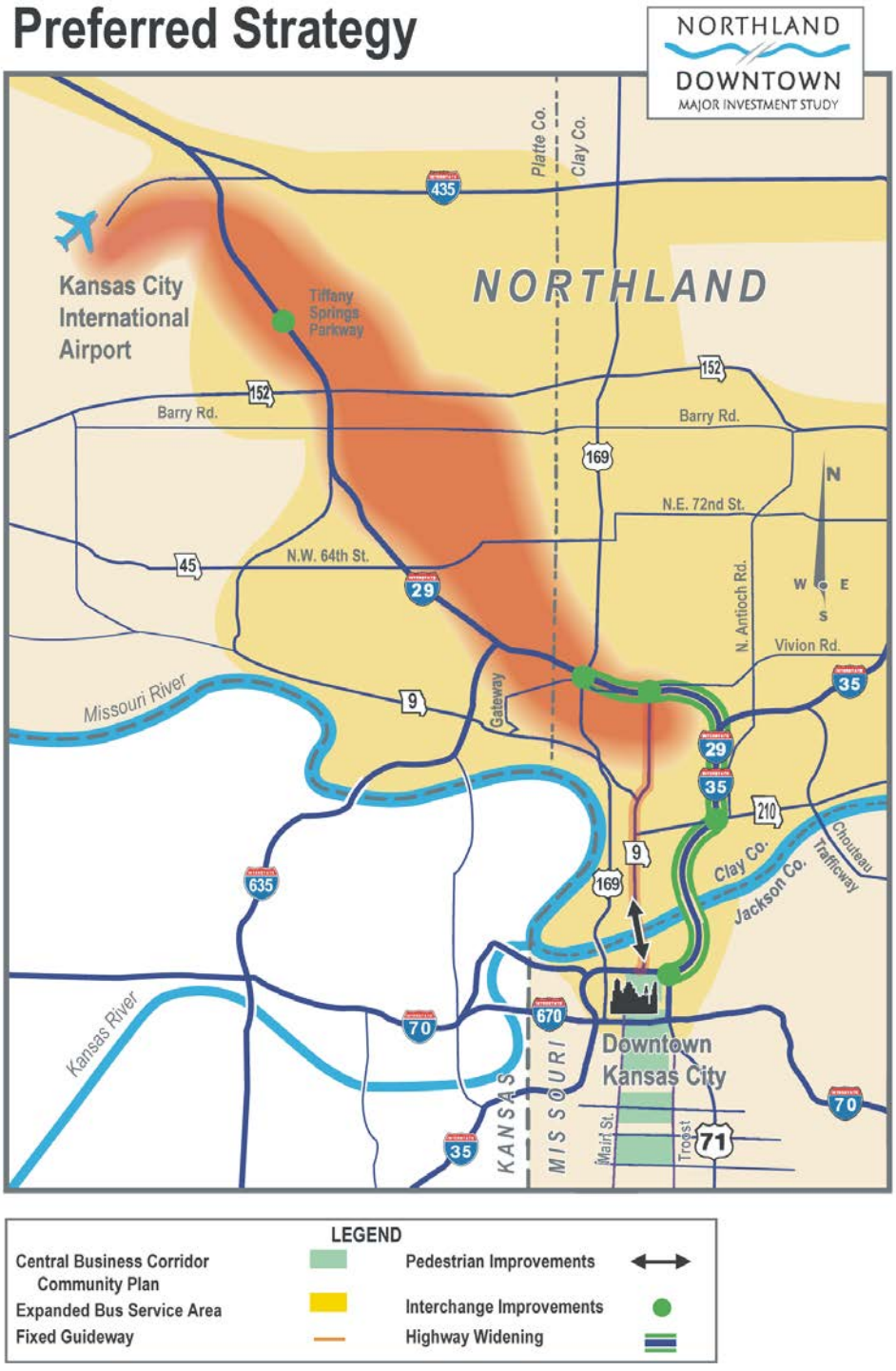
- When Alternative E (Low Cost Improvements plus LRT to KCI Airport) is added, a reduction in vehicle miles traveled and the travel time is shown on the freeways. This is due to the fact that the auto trips pulled off the freeways to use LRT to the airport are longer trips, therefore the impact savings is greater. The magnitude in VMT savings is shown for all roadways, however, travel time savings is not as good as Alternative C – Partial Roadway without LRT.

- When Alternative F (Partial Roadway Improvements Plus LRT) is added to the No-Build, improvements to travel distance and travel time are observed for all roadways but not to the same degree as Alternative C. This is due to the added travel time and travel distance to access the LRT.

Table 3
Daily Regional Measures of Effectiveness
(Year 2020)

		Alt. A	Alt. B		Alt. C		Alt. D	
	MOE	Value	Value	Diff	Value	Diff	Value	Diff
Freeway & Expressway	VMT	33,196,206	33,210,458	14,252	33,250,992	54,786	33,224,528	28,322
	VHT	1,040,907	1,042,516	1,610	1,032,408	-8,499	1,033,368	-7,539
All Roadways	VMT	57,068,891	57,051,632	-17,259	57,048,565	-20,326	57,115,316	46,425
	VHT	2,187,852	2,188,869	1,017	2,174,965	-12,887	2,183,380	-4,472

		Alt. A	Alt. E		Alt. F		Alt. E (KCI Option)	
	MOE	Value	Value	Diff	Value	Diff	Value	Diff
Freeway & Expressway	VMT	33,196,206	33,175,736	-20,470	33,266,052	69,846	33,168,954	-27,252
	VHT	1,040,907	1,035,760	-5,147	1,037,307	-3,599	1,034,166	-6,741
All Roadways	VMT	57,068,891	57,052,631	-16,260	57,039,102	-29,789	57,026,860	-34,869
	VHT	2,187,852	2,183,018	-4,833	2,178,675	-9,177	2,179,784	-5,591



Bike/Pedestrian Recommendation

- Missouri River Crossing –
  - ✓ Include **bike/pedestrian crossing** on the existing Heart of America Bridge (short-term).
  - ✓ Construct **new bike/pedestrian crossing** in combination with the future fixed guideway transit bridge crossing.
- Access Across I-29 – Include **provisions for pedestrian and bicycle access** across I-29 as part of future interchange improvements (see Highway Recommendation).

Transit Recommendation

- Bus Service – **Expand existing bus service** in the Northland including:
  - ✓ More frequent service on existing routes and new service on new routes.
  - ✓ Additional transit centers and park-and-ride lots.
  - ✓ Sufficient bus maintenance capacity to support new and expanded service.
- Fixed Guideway Transit (Light Rail or Bus Rapid Transit) –
  - ✓ Implement an **initial, first stage fixed guideway transit line** from the vicinity of I-29 and US 169 to Downtown, where it would connect with one or more other lines to form a regional system. Further consideration would be given to the transit technology – LRT or BRT – and to candidate alignments and station locations. The transit line would utilize an exclusive Missouri River bridge located immediately east of the Heart of America bridge.
  - ✓ Continue planning for a **future extension of fixed guideway transit** along the Line Creek alignment to the KCI Airport.
  - ✓ Update the City of Kansas City **Major Street Plan** to further indicate the conceptual fixed guideway alignment from Downtown to KCI and continue corridor preservation actions.

Highway Recommendation

- ITS Improvements – Include **variable-message signing** on US 169/Route 9 Corridors for travel route information as part of MoDOT's Intelligent Transportation System Scout project.
- Travel Demand Management Policies – Implement MARC's regional transportation **demand management policies and tools** in the Northland~Downtown MIS Corridor.
- US 169/Downtown Connection –
  - ✓ Construct 5th/6th Street and Broadway **intersection improvements** by the City of Kansas City and MoDOT.
  - ✓ Analyze improving the connection with **direct flyover ramps** between the Broadway Bridge and I-35 or the downtown street system.
- I-29 Corridor –
  - ✓ **Reconstruct and upgrade existing interchanges**, with or without I-29 mainline improvements:
    - Route 210 Interchange
    - North Oak Trafficway Interchange
    - US 169 Interchange
    - Tiffany Springs Interchange.
  - ✓ **Widen and upgrade mainline lanes** from US 169 to the Downtown Loop to generally provide an eight-lane section with auxiliary lanes as needed, including a new Paseo Bridge.
  - ✓ **Reconstruct and upgrade existing interchanges** along with the I-29 mainline improvements:
    - Paseo Boulevard Interchange
    - Front Street Interchange
    - Levee Road Interchange
    - Bedford Avenue Interchange
    - 16th Avenue Interchange
    - Parvin Road Interchange
    - I-35 Interchange
    - Davidson Road Interchange
    - Vivion Road Interchange
- Downtown Loop Enhancements –
  - ✓ Improve **direct access into and out of Downtown** with new connections to the northeast corner (i.e., Charlotte and Harrison Frontage Roads)
  - ✓ Further consider **enhancements to the north and south legs of the Loop**, such as decking over the freeway and/or access management improvements.
  - ✓ **Coordinate Loop enhancements** with the I-70 Major Investment Study (currently underway).
- Joint Development Opportunities – **Consider space provisions** for fixed guideway transit as part of the North Oak Trafficway Interchange, pedestrians, and park-and-ride lots.

Benefits of Preferred Strategy

The Preferred Strategy provides the combination of pedestrian, transit and roadway improvements that best serve the Northland for the following reasons:

- **System Preservation** – Expands the existing bus transit system in the Northland. Much of the I-29 Corridor is in need of rehabilitation/resurfacing and the roadway improvements address these needs.

- **Personal Mobility and Quality of Life** – Enhances personal mobility and the quality of life within the Northland~Downtown Corridor. This is accomplished through:

  - ✓ Improved access to transit service, particularly with the expanded bus service combined with the fixed guideway improvements.
  - ✓ Improved north-south and east-west mobility in the Northland.
  - ✓ Enhanced highway and transit connections across the Missouri River with enhanced access into Downtown.
  - ✓ New connections across the river for non-motorized modes.

  Should fixed guideway, including light rail and/or bus rapid transit, be implemented within the region, when combined with light rail south of the river, provides partial implementation for a regional rail system that would serve all residents. Of all the alignments considered, the Preferred Strategy attracts the highest number of transit riders in the corridor.

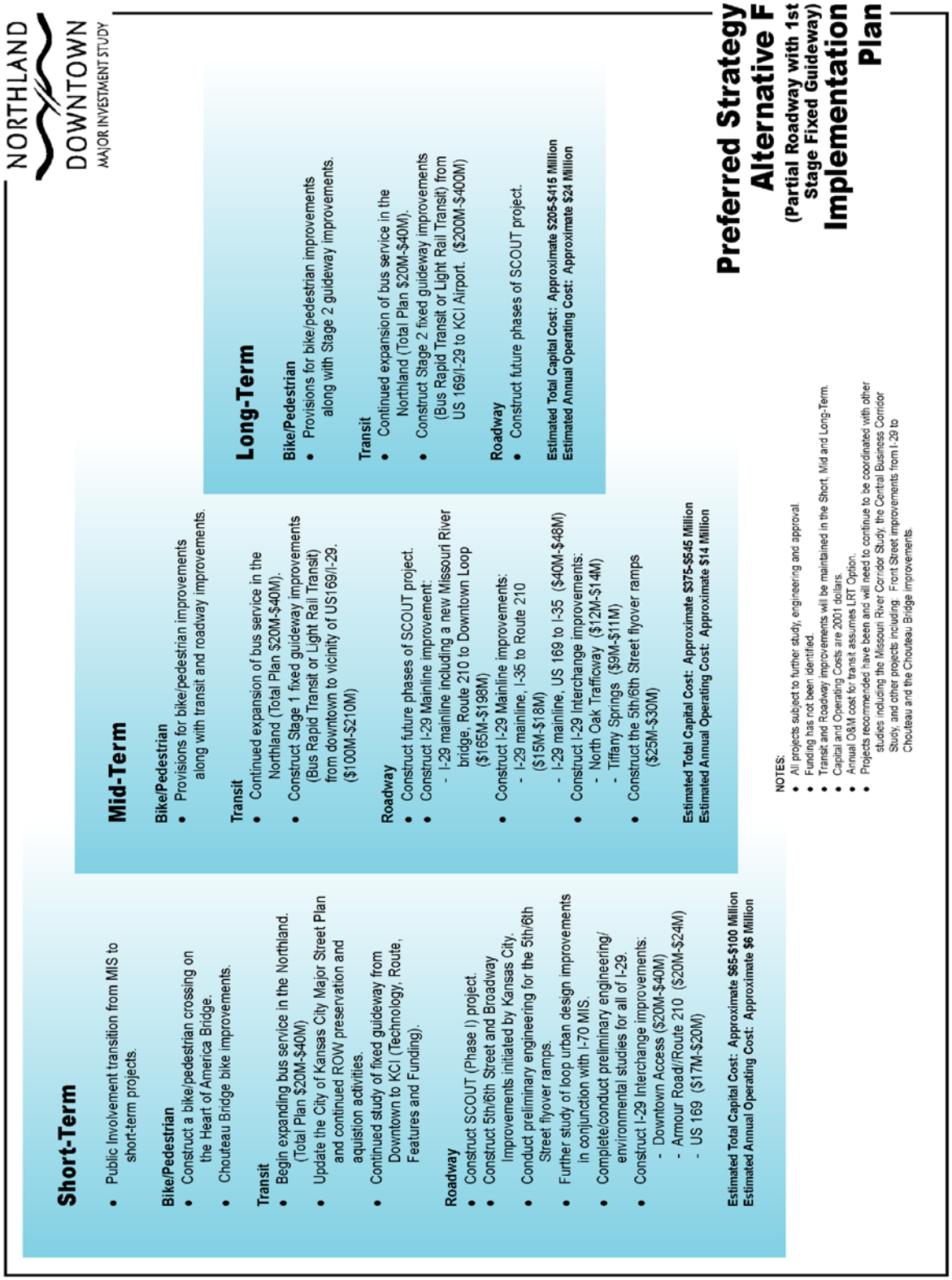
  The Preferred Strategy's roadway improvements provide a substantial reduction in vehicle hours traveled to Northland motorists. As a result, operational improvements in the roadway system are realized with improved travel times, improved travel speeds and reductions in travel delay.

- **Safety** – Provides safe and secure transit service. The improvements would bring the I-29 mainline and interchanges up to current design standards providing the highest safety. This in turn would reduce accidents in the Northland and provide improved emergency vehicle response.

- **Land Use and Development** – Promotes and facilitates the continued fulfillment of the established goals of FOCUS, in addition to land use plans for other communities in the Northland. Enhanced access into Downtown would be provided and a framework for further considerations of urban design treatments, such as decking, would be created for the Loop. Fixed guideway transit would provide a catalyst for new transit-oriented development around stations.

- **Regional Economy** – Would improve fixed connections between North Kansas City and Downtown, thereby further linking the area's economic centers. Each of these alternatives would be expanded in the future to further connect the economies of the Northland and Downtown. The Preferred Strategy provides the greatest person capacity potential across the Missouri River, more than any other alternative considered.

Implementation Plan



Features of the Preferred Strategy

Bike/Pedestrian Features

The bike/pedestrian elements of the Preferred Strategy are comprised of several basic elements:

Bike/Pedestrian Elements of Preferred Strategy

- Modify existing Heart of America Bridge to improve access in the short term.
- As part of a new fixed guideway transit bridge, plan for a bike/pedestrian facility in the long term.
- Provide improved access across I-29/I-35 as each interchange is improved.

In the more near term, modifications to the existing Heart of America Bridge will be provided to provide safer cross-river access for bicyclists and pedestrians. This recommendation entails the conversion of the existing roadway shoulders on the Heart of America Bridge for bike/pedestrian use. This plan would provide a cost-effective, short-term solution for improved bike/pedestrian access. MoDOT is currently investigating the details of how this could be accomplished, including bicycle-safe stormwater inlet grates, signage, and approach connections. These improvements should continue to be coordinated and planned by MoDOT. Then, as part of the long-term solution for the Study Corridor, bike/pedestrian facilities will be provided as part of the continued planning, design and construction of the separate fixed guideway transit bridge. This new bridge is to be located immediately adjacent and downstream of the existing Heart of America Bridge.

To further address the barrier created by the I-29 Corridor, which limits and constrains bicycle and pedestrian movements within the Northland, further evaluation of cross-corridor access needs to be provided. Within the limits of the I-29 improvements, opportunities to provide new cross-corridor access will be available as each interchange from Downtown to US 169 is reconstructed. These provisions could include extra space under the I-29 interchange bridge, or on the crossroad bridge, for a bikeway/pathway. Further coordination with the City of Kansas City, Missouri and MARC will need to be provided to identify and prioritize the cross-corridor access points, as well as to define the design parameters for the facility. This coordination will need to be conducted as part of the planning, design and construction of the I-29 Corridor improvements.

Transit Features

The transit elements of the Preferred Strategy are comprised of several basic elements:

Transit Elements of Preferred Strategy

- Expanded bus service to improve access to transit throughout the Northland.
- Fixed guideway transit implementation of an initial phase to improve transit connections across the river, including a new, exclusive transit bridge.
- Fixed guideway transit planning to ultimately provide transit connections between KCI and Downtown.

Bus Service

In the mid to late 1990s, the KCATA operated eight bus routes in the Study Area, providing a mix of express and fixed-route service to the Northland. These eight routes attracted a total average weekday ridership of around 1,250 passengers, or 2.6 percent of all riders on the KCATA system. The Northland routes were less productive, in terms of the number of

passengers carried per hour of service, than other bus routes on the system. The KCATA has made some adjustments in the Study Area service since the beginning of the MIS, and some moderate ridership increases have taken place.

The Northland~Downtown MIS recommends still further bus service expansion for the year 2020, recognizing that additional growth and development is expected to occur within the Study Area. A low cost expanded bus service strategy might include:

- Expanded service area, offering new bus service along Route 9 to Parkville and Riverside; and north of Route 152 to areas currently under served.
- More frequent service on existing routes.
- Additional cross-town bus routes.
- Neighborhood circulators.
- Express bus service along I-29 to Platte City and along US 169 to Smithville.
- Additional and enhanced transit centers, both major and minor.
- New park-and-ride facilities.

In the event that a fixed guideway transit system is developed in the Northland, this expanded bus system would be redesigned to offer feeder service to the fixed guideway. Improvements should be coordinated with the on-going Metropolitan transit initiative.

Fixed Guideway Transit

The Northland~Downtown MIS also recommends the continued planning and development of a fixed guideway transit system for the Northland. As used in this study, "fixed guideway transit" refers to a form of transit that has several basic characteristics:

- Moderate capacity (1,000 to 10,000 passengers per hour).
- Transit vehicles that operate in their own travel lane or tracks, separate from automobiles.
- Vehicles that are capable of operating in an urban environment, such as within street right-of-way, allowing for auto and pedestrian traffic to cross the guideway safely at grade.
- Passengers boarding the vehicles at stations spaced roughly a mile apart.

Fixed Guideway Transit in the Northland would include either light rail (LRT) or bus rapid transit (BRT) technologies, but does not include heavy rail, commuter rail or elevated and underground technologies.

The final recommendation of the Northland-Downtown MIS Committees does not specify either LRT or BRT as the preferred fixed guideway technology. However, for certain detailed technical analyses during the study, such as for ridership estimating, the fixed guideway was assumed to have the operating characteristics of LRT. During the study, a range of capital costs for BRT and LRT was developed, and is included in this report.

In later stages of the MIS, the fixed guideway analysis and recommendations were coordinated with those of the separate but concurrent Central Business Corridor plan, which was focusing specifically on more immediate implementation of light rail south of the Missouri River between the River Market and the Country Club Plaza. Community input in the CBC Study urged extension of the light rail route proposed south of the river to include the Northland. As a result, the Northland/Downtown Study committees provided a preliminary northland alignment recommendation specifically for light rail to assist the CBC study effort. However, the final recommendation identifies a preferred, specific fixed guideway alignment and station locations which could be implemented with either LRT or BRT.

The MIS recommends that any Northland fixed guideway investment be built in phases, with the first phase extending from Downtown to the vicinity of the I-29/US169 Interchange. Fixed guideway improvements in the Northland would most effectively function as an extension of an initial transit line serving the urban core (i.e., River Market to Country Club Plaza). Preliminary ridership estimates developed early in the study also suggested that a Northland extension to KCI would not generate sufficient demand by 2020 to justify the additional investment in fixed guideway transit north of the I-29/US 169 Interchange.

Early in the study, the Steering and Advisory Committees did consider the advantages and disadvantages of two potential fixed guideway alignments north of the interchange, one following I-29 to KCI and the other following Line Creek. The Committees expressed a preference for the Line Creek alignment, and recommended that the City of Kansas City and the KCATA take steps to protect and preserve the right-of-way for the future and eventual construction of a fixed guideway transit facility to KCI.

Three fixed guideway alignment options were considered for the portion of the Study Area between the I-29/US169 Interchange and Downtown (i.e., initial phase). Each alignment option would utilize a new Missouri River bridge located immediately downstream of the existing Heart of America Bridge. Each alignment would extend north from a River Market station located at 2nd and Grand , would cross the river on the new bridge, and would be located within the Burlington Avenue right-of-way within the city of North Kansas City. At the northern end of Burlington Avenue, in the vicinity of the Waterworks Park, the three alignment options diverge as follows. It was recognized that the other alignment options north of I-29/North Oak Trafficway split would be given further consideration in future project development studies.

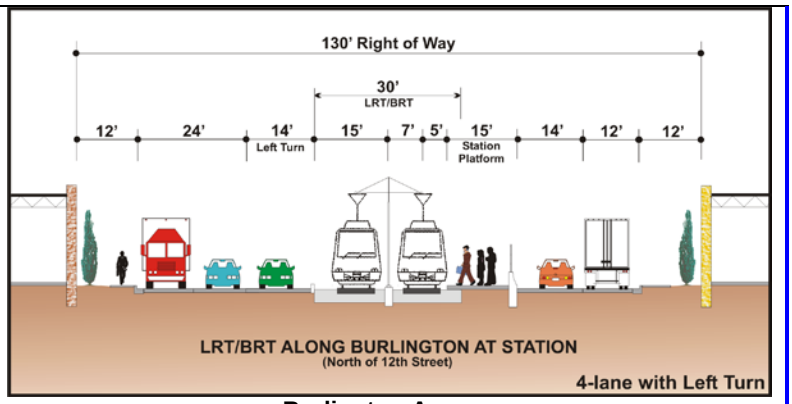
- **Option 1** – North side of Waterworks Park and the Water Plant to US 169, then north along the west side of US 169 to the I-29 Interchange, then west along the southern side of the I-29 right-of-way to Waukomis Drive.

- **Option 2** – North Oak Trafficway to Vivion Road, west on Vivion Road to the I-29/US 169 Interchange. The alignment would then follow the north side of I-29 to Waukomis Drive, or follow Vivion Rd., the west side of US 169, and the south side of I-29 to Waukomis.

- **Option 3** – North side of Waterworks Park and the water plant to Northwest Platte Road, then following along NW Platte Road to Riverside and Vivion Road to Waukomis Drive.

At its April 27, 2000 meeting, the Steering and Advisory Committees agreed that, to simplify the analysis, the study team would focus on an alignment that would follow North Oak Trafficway from the Waterworks to an interim, first stage terminus in the vicinity of I-29. It was recognized that the other alignment options would be given further consideration in future project development studies.

Fixed Guideway Technology	Light rail transit (LRT) or bus rapid transit (BRT), to be determined by regional system operations and connectivity.
Typical Section	The fixed guideway typical section will depend on the type of technology, the surrounding environment and the exclusiveness of the guideway operations.



Burlington Avenue

Missouri River Crossing	Construct a new and separate fixed guideway bridge immediately downstream of the existing Heart of America Bridge. Include provisions for pedestrians and bicycles on new bridge. If the improvement is BRT, the existing Heart of America Bridge could be utilized in the interim.
Termini and Potential Station Locations	For the studied alignment, the first stage fixed guideway would be five miles long. Seven potential locations for fixed guideway stations were identified: • I-29 and North Oak Trafficway (northern terminal) • 42nd and North Oak Trafficway • 29th and Burlington Avenue • 18th and Burlington Avenue • 10th and Burlington Avenue • Riverfront Park • 2nd and Grand (connection to regional system)
Ridership	See table below. The base system includes the planned regional bus system plus the LRT system recommended in the CBC Community Plan for all parts of the region except the Northland. In the Northland, the base system consists of existing plus committed transit services. The ridership estimates for the first stage fixed guideway system assume the implementation of expanded bus system in the Northland, as well as LRT or BRT.

2020 Ridership	Base	First Stage
LRT Ridership:		
• Corridor	0	3,000
• System	12,900	16,000
Total Unlinked Transit Trips:		
• Corridor	5,800	11,100
• System	81,400	87,200
Total Linked Transit Trips:		
• Corridor	5,200	7,600
• System	57,100	59,600
Change in Linked Trips	-----	2,400

Issues	There are several issues that will need to be investigated in future studies: • Location and frequency of new Northland bus service. • Technology (LRT or BRT). • Alignment between Downtown and I-29/US 169. • Station locations and guideway configuration.

The recommended transit improvements will require additional capital and operating resources, above and beyond those currently available to the KCATA. The capital and operating costs of the first stage fixed guideway system, including associated bus service improvements, are shown below. These estimates assume that LRT will be the chosen technology. The base system is assumed to include the planned regional bus system plus the LRT system recommended in the CBC Community Plan for all parts of the region except the Northland. Funding sources for the regional fixed guideway system and for the Northland bus service expansion have not yet been identified.

Transit Cost Estimate - Million 2001 Dollars

Cost Item	Base System	First Stage Fixed Guideway [(b)]
Capital Costs:		
• Bus	Base	$37 [(a)]
• Rail	Base	$210 [(a)]
Annual Operating and Maintenance Costs, Systemwide		
• Bus	$86	$101
• Rail	$13	$16

[(a)] Capital costs are in addition to the cost of the Base System.
[(b)] Capital and operating cost estimates assume that the fixed guideway is LRT.

Given the magnitude of these costs, it is likely that any fixed guideway system would be developed in stages, starting in Downtown and continuing north to KCI as funding becomes available. To make sure that the right-of-way for a fixed guideway system remains available as the corridor develops, the Steering and Advisory Committees recommended that further alignment planning be closely coordinated with the City of Kansas City, and that the City update its Major Street Plan to show the alignment as decisions are made.

Highway Features

The highway elements of the Preferred Strategy are comprised of several basic elements:

Highway Elements of Preferred Strategy

- Low cost improvements to make the existing highway system operate better.
- Spot US 169 interchange improvements to relieve existing bottlenecks.
- Mainline I-29 Corridor improvements to expand corridor connections between the Northland and Downtown, including capacity over the Missouri River.
- Downtown Loop enhancements to improve the Loop and Downtown highway access, operations and to enhance development opportunities and land use connectivity.
- Joint development opportunities to fully integrate the multi-modal aspects of the Preferred Strategy with the highway improvements.

Low Cost Improvements

Analysis of the existing river crossing bridges revealed that the Broadway Bridge (US 169) and Heart of America Bridge (Route 9) currently operate as a tandem. Whereas the Paseo Bridge serves the Northland as a whole, the Broadway and Heart of America bridges collectively serve the more western portions of the Northland, thereby corresponding more directly with the Study Corridor. Because of the interconnection of the US 169 and Route 9 corridors just west of Waterworks Park, these two bridges tend to operate as a single connection into Downtown from the Northland. By virtue of this interrelationship, these bridges provide redundancy within the highway system for the Study Corridor. Travelers to and from Downtown can utilize either corridor without significantly altering their travel path.

To allow travelers to make an informed decision on which route to take they must have accurate and timely information on traffic conditions. At the present time, drivers receive this information thorough radio traffic reports that are often out of date and inaccurate. This problem results from a lack of real-time information on traffic operations in the corridor. To collect real-time information consistent with the KC Scout system, loop detection and closed-circuit television surveillance cameras must be deployed. The loop detectors assist in identifying incidents impacting traffic flow and the closed-circuit television cameras allow assessment of incident severity and the appropriate response. The information collected in the corridors would then be processed and disseminated by personnel at the traffic operations center through dynamic message signs and other systems designed to provide information to the public and commercial traveler information providers, such as traffic reporting services.

The anticipated KC Scout deployment provides loop detection and closed-circuit television surveillance along I-29 from the Downtown Loop to just south of the I-29/I-35 split. Along US 169 and Route 9, video surveillance of the Broadway (US 169) and Heart of America bridges (Route 9) is to be provided. It is recommended that the deployment of the Scout project include dynamic, variable message signs in advance of the I-29/US 169 Interchange and the US 169/Route 9 Interchange to convey real-time information on travel conditions across the Missouri River bridges.

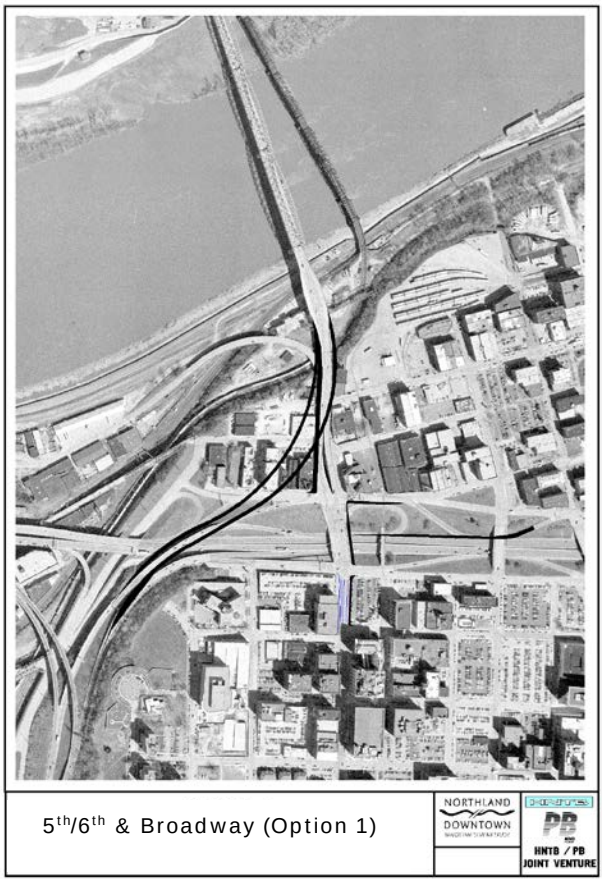
Other low cost improvements that are recommended as part of the Preferred Strategy, though of a more policy nature, include regional-level steps that reduce or positively change travel demands within the Study Corridor. Examples of these policy-level improvements include ride-sharing programs, telecommuting and land use measures. Each of these steps would need to be initiated, coordinated and managed at a regional level, involving all transportation agencies. It is recommended that further consideration by MARC and other regional agencies be given to the potential application of these transportation demand management measures within the region and the Northland~Downtown MIS Study Corridor.

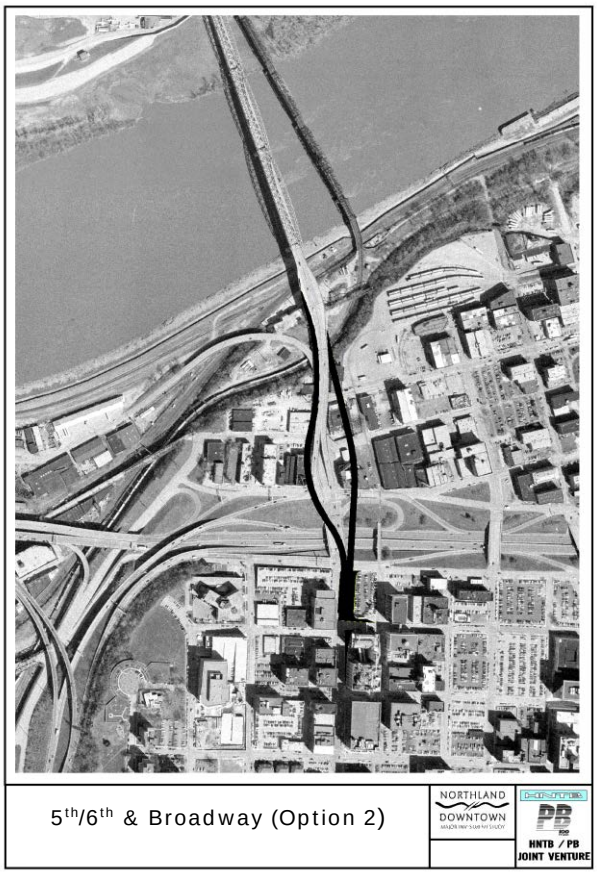
Specific to the Study Area, it is recommended that travel demand management improvements be implemented within the industrial areas surrounding the Missouri River. Several of the interchanges along I-29 are substandard, with short acceleration and/or deceleration lanes and poor merge areas. Consequently, during either the morning or evening commute periods, trucks operations contribute considerably to the corridor's congestion and travel delays. Given the limited space and close proximity of these interchanges, namely the Levee Road, Bedford Avenue, and 16th Street Interchanges, and given the limited alternative access options, it is recommended that truck access from I-29 be limited or prohibited during the peak commute periods. This improvement would need to be implemented through a coordinated program with the business associations located within the North Kansas City industrial complex.

Spot US 169 Interchange Improvements

Operational analyses of the Study Corridor have shown that there are several isolated improvements that when completed would improve the operation of the highway system as a whole. One of these spot improvement recommendations is the connection of US 169 (the Broadway Extension) to Downtown. This connection currently entails an interchange with I-35 in the northwest corner of the Loop, including signalized intersections with 5th and 6th streets. These intersections currently cause traffic delays, which in the morning create traffic backup onto the Broadway Bridge, typically extending north beyond the Downtown Airport. This problem is partly caused by the insufficient capacity of the connection to adequately serve the high percentage of turning traffic. It is estimated that approximately 45% of the traffic traveling through the intersections is not destined to Downtown. By improving this connection, it is estimated that up to ten minutes of delay per vehicle could be saved.

Two interchange design concepts have been identified for this connection. Both of these concepts (Option 1 and Option 2) are based on the premise of separating the Downtown-oriented traffic from the turning traffic to improve the efficiencies of each movement. Option 1 consists of constructing fly-over ramps between US 169 (Broadway north) and I-35 (south). Option 2 involves a three-level interchange that enables the turning movements to avoid conflicts with the through movements. Both concepts will need to be investigated further in a more detailed study following this MIS. More detailed considerations will need to be given to the feasibility of the construction, the impacts to the adjacencies and the operational benefits of the concepts.





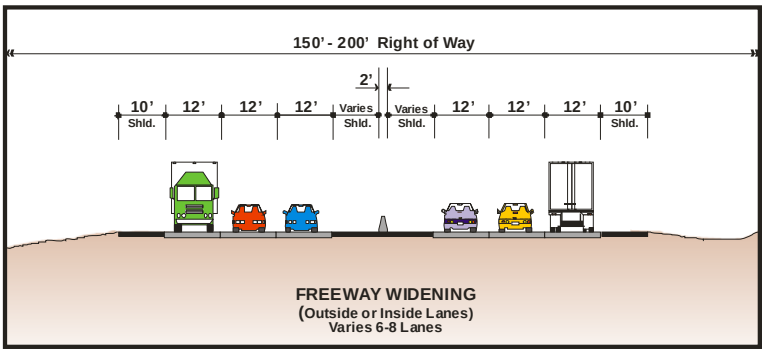
Mainline I-29 Corridor Improvements

Initial analyses of the three existing highway corridors that currently connect the Northland with Downtown determined that the I-29 Corridor is the best and most appropriate corridor for highway capacity expansion. The tight physical constraints of the US 169 (Broadway) Corridor preclude conventional widening. (Among other reasons the highway can not be double decked without adversely impacting the operations of the Downtown Airport.) Furthermore, Route 9 (Burlington Avenue) is a six-lane urban arterial with a series of traffic signals with no real opportunity for expansion without significant impacts to adjacent properties and the North Kansas City community. The I-29 Corridor has the additional advantage of serving the whole Northland, providing access into Downtown for both the I-29 and I-35 Corridors. The Paseo Bridge crossing is also a critical link in the I-35 International Trade Corridor (NAFTA), which extends from the international borders of the United States with Mexico and Canada.

Based on the operational analyses of the existing I-29/I-35 roadway under both current and 2020 traffic conditions, it was determined that two types of roadway improvements to this corridor are needed – mainline improvements and interchange improvements. Mainline improvements entail adding through travel lanes by widening the existing roadway section. Interchange improvements represent more localized, spot upgrades to address isolated problems that impact the system's overall capacity.

- **Mainline Improvements** – I-29 currently consists of primarily two through lanes in each direction from US 169 to the Downtown Loop. However, at the I-29/I-35 Interchange, I-29 is reduced to one through lane in the south direction. In general, I-29 south of the I-29/US 169 Interchange has insufficient mainline capacity to efficiently serve the projected travel demands. Additional through lanes are needed between US 169 and the Downtown Loop, including the crossing of the Missouri River. Features of these improvements are as follows:

Lane Configuration	Add two general-purpose lanes (one northbound and one southbound) between the I-29/US 169 Interchange and the I-29/I-35 Interchange to provide a six-lane section. Also, add four general-purpose lanes (two northbound and two southbound) between the I-29/I-35 Interchange and the Downtown Loop to provide an eight-lane section. From a system perspective, one additional lane in each direction would be added from US 169 and another additional lane in each direction would be added from I-35, thereby providing eight through lanes into the Downtown Loop. Auxiliary lanes would be provided between: • North Oak Trafficway and I-35 • I-35 and Route 210 • Bedford Avenue and Levee Road • Front Street and Paseo Boulevard

Roadway Section	Between the I-29/US 169 and I-29/I-35 Interchanges, the additional roadway lanes would be added to the outside in each direction. The open median would be closed with a median barrier and full-width inside shoulders would be provided. South of the I-29/I-35 Interchange, the additional lanes would also be provided outside of the existing lanes. The existing median barrier in this segment would be maintained and the existing pavement would be restripped to provide full-width inside shoulders. South of the I-29/I-35/Route 210 Interchange, retaining walls could be necessary to avoid direct impacts to adjacent land use.  **I-29 Widening**
Missouri River Crossing	The existing Paseo Bridge would be converted to one-way traffic and would provide four southbound lanes. A new bridge immediately adjacent to and downstream of the existing bridge would be constructed to provide four northbound lanes. Additional study will need to be conducted to determine if a companion structure should be constructed, as assumed by this MIS, or whether the existing bridge should be replaced in its entirety with a new eight-lane bridge.
Issues	There are several issues that will need to be investigated in future studies: • Constructability. • Maintenance of traffic during construction. • Provisions for potential future widening of I-35. • Extent of reusable existing I-29/I-35 pavement.

- **Interchange Improvements** – There are a number of interchanges along the I-29 Corridor with deficient operations. The majority of these are located within the limits of the mainline improvements. These deficiencies are the result of either a lack of capacity at the individual interchange, or too close of spacing with adjacent interchanges. For some of these interchanges, namely Route 210, North Oak Trafficway, US 169 and Tiffany Springs, improvements are warranted with or without the mainline I-29 improvements. In some cases, due to the close spacing of the access points, it is recommended that an existing interchange be eliminated. In these cases, access would be maintained through the adjacent interchanges.

To further define the general scope and concept of the interchange improvements, and to assess the feasibility of the improvements, generalized improvement layouts for each interchange were developed. These layouts are in concept only and would be subject to more detailed study and investigation by MoDOT following the MIS.

General features of these I-29 interchange improvements, in concept, are as follows:

Tiffany Springs	The existing interchange consists of a diamond-type interchange. Existing problems at this interchange result from high traffic volumes for the north to east movement in the morning and the west to south movement in the evening. Also, the close proximity of the Ambassador Drive intersection immediately to the east of the interchange impedes traffic flow at the eastern ramp terminal. Earlier planning by the City of Kansas City, Missouri showed loop ramps in the northwest and southeast quadrants, but land development has subsequently occurred that prohibits the construction of these loops. Consequently, it is recommended that a single-point interchange be constructed at this location with dual left-turn lanes. To account for the traffic flow between I-29 and Ambassador Drive, it is suggested that the interchange configuration be modified such that the north to east movement and the north to Ambassador Drive movement be located at the Tiffany Springs/Ambassador Drive Intersection.
US 169	This interchange marks the northern point for the additional lane to be added to I-29 in each direction. These lanes would be added through the continuation of the south to east ramp and its complement (i.e., west to north ramp). Improvements to this interchange would entail providing two through lanes along northbound US 169. This would be accomplished by providing a continuous lane on the outside of northbound US 169 for the west to north ramp. This lane would then drop at the US 169/56th Street Interchange – the next interchange to the north.
Vivion Road	Due to the close proximity of this interchange to US 169 and the access available at the next interchange to the east (i.e., I-29/North Oak Trafficway Interchange), it is recommended that this interchange be closed. By doing so, the operations along I-29 would be improved through the elimination of several short, deficient and unsafe weave sections.

North Oak Trafficway	With the potential closure of the Vivion Road Interchange, full movements would need to be provided at this location. Currently, the interchange movements in the northwest quadrant are provided by slip ramps located along Vivion Road a relatively short distance to the west. Space limitations exist due to the close proximity of Vivion Road, which is located parallel to and a short distance north of I-29. It is recommended that this interchange be replaced by a full single-point diamond interchange. This reconfiguration would displace those businesses currently located in the southwest corner of the North Oak Trafficway/Vivion Road intersection. Moving the intersection to the north, requiring a minor relocation of Vivion Road, could provide greater distance between this intersection and the interchange.
Davidson Road	This interchange would be maintained in its current configuration and location.
I-35	The configuration of this interchange would be maintained, but some improvements would be necessary due to conflicts with ramp bridge substructure elements. Because of the widening of the I-29 roadway, from its current configuration to three through lanes in each direction, the I-29 southbound to I-35 northbound ramp bridge would need to be replaced. From a system perspective, the three through lanes in each direction from I-29 would combine with two through lanes in each direction from I-35 to create a ten-lane section between this interchange and Route 210. The outside lanes for this section would be auxiliary lanes and would terminate and begin at the I-29/Route 210 Interchange.
Parvin Road	Due to the close proximity of this interchange to the I-29/I-35 Interchange and the availability of access at the I-29/Davidson Road Interchange or the I-35/Antioch Road Interchange, it is recommended that the southbound off-ramp and the northbound on-ramp be closed at this location. By doing so, the operations along I-29 would be improved through the elimination of several short, deficient and unsafe weave sections. This interchange would therefore be converted to a half-diamond type interchange with ramps to and from the south.

Route 210	This interchange currently consists of a tight clover-leaf type interchange with short weave sections on I-29 and Route 210. The Route 210 crossing is highly skewed with development in the northwest and southeast quadrants that prohibit the expansion of the interchange. Alignment adjustments to reduce the crossing's high degree of skew are not prudent. Given these constraints, it is recommended that this interchange be converted to a diamond-type interchange. This interchange would be atypical due to the skew -- the southbound and northbound ramps would share the same ramp terminal intersection. This intersection would be located underneath the I-29 overpass and special lighting and sight distance considerations would be required. Driver expectancy would also be an issue that would need to be addressed. This configuration would introduce three traffic signals along Route 210.
16th Avenue	This interchange would be maintained in its current configuration and location.
Bedford Avenue	This interchange would be maintained in its current configuration and location. Due to its close proximity to Levee Road, minor adjustments should be made to the ramp nose locations to maximize the distance between the interchange ramps.
Levee Road	This interchange would be maintained in its current configuration and location. Due to its close proximity to Bedford Avenue, minor adjustments should be made to the ramp nose locations to maximize the distance between the interchange ramps.
Front Street	Several optional interchange improvements have been identified at this location as part of the ongoing planning for the Front Street improvements and the Riverfront Development. Issues that need to be addressed at this location include: 1) the close spacing of this interchange and the Paseo Boulevard Interchange to the south, 2) the ramp grades for better service to the high number of trucks, and 3) better continuity with Front Street for improved system access from the Chouteau Trafficway into Downtown via the new Grand Avenue Viaduct. One optional interchange would be a tight or single-point diamond-type interchange with Front Street reconfigured over I-29. Issues potentially affecting this interchange include the coordination with nearby development, the status of the existing Paseo Bridge, and the feasibility of spanning over I-29 with a new Front Street.

Paseo Boulevard	This interchange is deficient primarily due to the current lane shifts required for I-29. It is recommended that the priorities between I-29 and Paseo Boulevard be switched such that I-29 has priority and better continuity. With this arrangement, Paseo Boulevard traffic must exit or enter I-29. Due to the close proximity of Front Street, auxiliary lanes would be necessary between this interchange and the I-29/Front Street Interchange to the north.

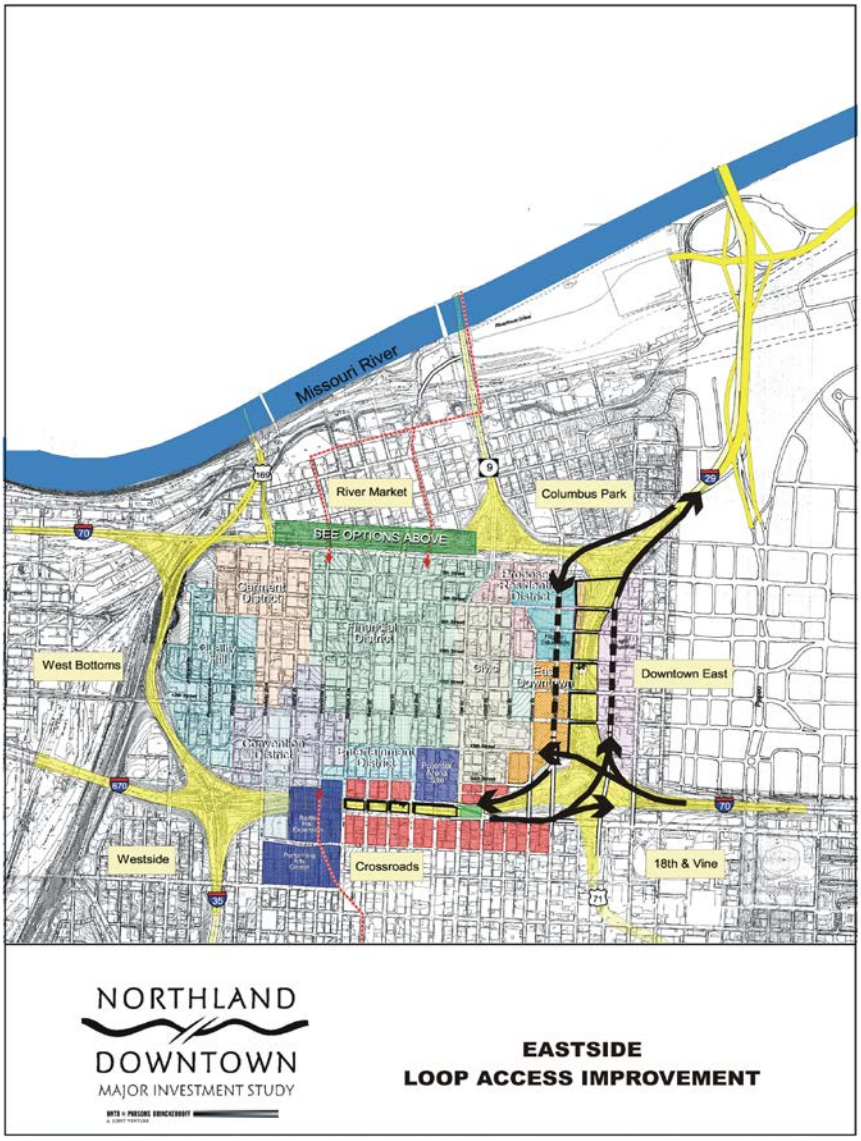
Downtown Loop Enhancements

The Downtown Loop demarcates the southern terminus for the I-29 improvements. Improving the I-29 Corridor and the Paseo Bridge crossing provides the opportunity to enhance not only the connection of this radial corridor into the Downtown Loop and the CBD street system, but the Loop system as a whole. As it relates to the Downtown Loop and land use issues, the goals of the Preferred Strategy include:

- Promote downtown as "destination" for travel.
- Provide efficient access in and out of downtown.
- Provide safe and modern transportation facilities.
- Complement major street plan and traffic circulation patterns within and around the Downtown Loop.
- Supports land use and development goals of FOCUS for downtown and central business district.
- Complement the Central Business Corridor Community Plan.

Through a conceptual traffic and land use planning process, the Preferred Strategy recommendations relating to the Downtown Loop include:

- **Maintain the Existing Loop Functionality** – The existing 2-way Loop configuration best serves Downtown. Other concepts such as a boulevard for the northern leg of the Loop, or one-way Loop operations, or partial one-way Loop operations, would not serve the area's land use as effectively, would cause inefficiencies in travel and would be costly to implement.
- **Connect New Capacity Directly into Downtown** – The new lanes added to the I-29 Corridor will be connected directly into the Downtown street system, thereby serving direct access into Downtown and positively impacting the Loop's operations. The preferred option is to connect the two new I-29 lanes in each direction to a new one-way frontage road system centered on the existing eastern leg of the Loop along Charlotte and Harrison Streets. However, the feasibility of this concept needs to be further investigated. A similar connection to I-70 will need to be investigated at the southern end of the frontage road system. Other access options for I-29 include Paseo Boulevard and/or North Oak Trafficway.



- **Consolidate Downtown Access** – In conjunction with the enhanced direct access created by the Charlotte/Harrison frontage road system, consolidate the existing access along the eastern leg to eliminate the breaks in access within this portion of the Loop.

- **Consider Further Enhancements of the North and South Loop Legs** – Surface land use connectivity is an issue across both the north and south legs of the Loop. The northern leg creates a barrier between Downtown and the River Market, and similarly, the southern leg separates the Freight House District from Downtown. Additional study should be conducted to consolidate access points within these legs of the Loop, and to enhance connections across the Loop freeway. Options would include decking over the freeway.

- **Coordinate Loop Improvements with I-70 MIS** – The southern end of the Charlotte/Harrison frontage road system will need to be coordinated with the improvements identified for the I-70 Corridor.

Joint Development Opportunities

Continued consideration will need to be given to the integration of the various multi-modal elements of the Preferred Strategy with the highway improvements. The fixed guideway transit recommendation entails a separate bridge crossing for the Missouri River. However, the potential would exist for the interaction of the fixed guideway alignment with the I-29 right-of-way between North Oak Trafficway and Waukomis Drive Interchanges. Other opportunities include provisions for pedestrian crossings as part of interchange reconstruction improvements and park-and-ride lots for the future fixed guideway transit investments.

Other Concepts Considered

The Preferred Strategy recommendation for the Northland~Downtown MIS is the culmination of a systematic and comprehensive study process. More detailed technical analyses of the candidate strategies were incrementally performed to focus the study on those types of improvements that would best serve the Study Area. Coordination with stakeholders and community leaders was instrumental in supporting the technical analyses.

Concepts Eliminated	
Commuter Rail – Provide commuter rail service between KCI and Downtown utilizing existing rail lines.	Existing rail lines between KCI and Downtown are located far outside the Study Corridor, and there is insufficient travel demand to justify an investment of new heavy rail solely for this specific travel market. Travel times between KCI and Downtown would not be attractive as compared to an auto trip.
High-Occupancy Vehicle Lanes – Construct new, exclusive use lanes to US 169 or I-29 for High-Occupancy Vehicles (HOV) during peak periods. The HOV lanes would extend from the I-29/US 169 Interchange area into Downtown, bypassing the most congested segments of the highway system. This alternative would include bus system improvements.	There is insufficient space to utilize the US 169 Corridor. Construction costs for a separated HOV system would be cost-prohibitive. To function effectively, the HOV system would need to have direct and separate access into Downtown. Significant line-haul demand for bus transit service between the Northland and Downtown is not available to fully utilize the HOV system. The travel benefits of the system would not warrant the cost of construction.
New River Bridge Crossing – Construct a new river bridge either upstream or downstream of the existing Downtown bridges to bypass the Loop.	A new bridge crossing would not attract sufficient traffic to relieve the over-capacity operations of the existing Downtown bridges.

At the outset of the MIS, the issues and transportation-related problems within the Study Area were defined. Based on the travel markets and travel characteristics of the Study Area, a range of improvement concepts was conceived. Through a structured evaluation process of gauging the effectiveness of each concept or strategy in relieving the identified problems within the Study Area, a more defined set of alternative improvement strategies was identified. Each initial concept, ranging from low-cost management strategies to more expensive capacity expansion strategies, was evaluated and considered on its own individual merits. Through this process, it was determined that no standalone strategy fully met the study's objectives. Yet several of the initial strategies exhibited benefits that warranted more detailed consideration. Consequently, a

more narrow range of alternative strategies was defined which combined the best attributes of the various modal concepts into an ascending degree of commitment (i.e., construction costs) and inter-modal composition. Through this process, it was determined that the Preferred Strategy was the best mix of the initial modal concepts, and was worthy of further pursuit by each respective agency subsequent to this MIS.

Issues for More Detailed Consideration

There are a number of unresolved issues from the Northland~Downtown MIS that require more detailed study. These unresolved issues are a result of study analyses or Steering/Advisory Committee comments. Some issues will be answered with additional planning studies and some in the more detailed phases of design.

- **Bicycle/Pedestrian** – Bicycle/Pedestrian issues that require more detailed study are primarily related to location and design. These issues should be addressed as roadway and transit projects are moved to more detailed stages of development.

- **Transit** – Expansion of the bus service and transit centers in the Northland is a on-going process that is being coordinated by the KCATA. More detailed study will be needed of fixed guideway from Downtown to KCI related to technology, route, features and funding.

  - ✓ *Technology* – Pros and cons were identified for fixed guideway transit technologies. The MIS did not identify the best technology for the Northland. Both Bus Rapid Transit (BRT) and Light Rail Transit (LRT) are both viable options. This issue still needs to be addressed in more detail. LRT technology was used in the study for analysis purposes.

  - ✓ *Route* – The MIS's southern terminus would connect with a planned light rail system for the Southtown. The connection would be in the vicinity of 2nd Street and Grand Boulevard. The northern terminus would be KCI Airport. The Steering/Advisory Committee did identify Burlington Street as the best corridor in the southern section, crossing the Missouri River at the Heart of America Bridge, on a separate structure. North of the intersection of Missouri Route 9 and North Oak Trafficway, no specific route was selected. For analysis purposes, the North Oak Trafficway alignment was carried north to I-29. North of I-29, the Steering Committee did decide that an alignment that roughly followed Line Creek was favorable over the I-29 corridor alignment.

  - ✓ *Features* – Fixed guideway features such as transit station locations need to be identified in later stages of project development. Also, center or outside guideway alignment within the roadway right-of-way also needs to be determined.

  - ✓ *Funding* – Funding for the fixed guideway will also need to be determined.

    All of these issues will be given further consideration in future project development studies, such as the National Environmental Policy Act (NEPA) process.

- **Roadway** – Preferred roadway improvements are identified in the MIS at a planning level of detail. Subsequent stages of development of roadway improvements would be addressed in preliminary engineering and final design stages. The early stages of development are contained within the NEPA process. Within this process, issues related to the degree of impacts to adjacent properties will be addressed. This stage will identify right-of-way needs and environmental impacts in more detail. Based on the degree of environmental impacts, more detailed design decisions can then be made. The following issues should be studied in more detail:

  - ✓ *Environmental Issues* – Environmental issues were identified at a planning level in the MIS. Environmental impacts that should be studied in more detail in subsequent phases of development include air quality, noise quality, impacts to natural resources and social impacts. Natural resource impacts include impacts to the Missouri River as a result of the Paseo Bridge improvement. Missouri River impacts could also include impacts to endangered and threatened species. The Pallid Sturgeon, along with other species, may have habitats within the Missouri River. Numerous hazardous waste sites are known to exist along I-29, especially in the vicinity of I-29 and Route 210 Interchange. Impacts to parklands are also a concern. Areas located just north and south of the Missouri River are designated as proposed parks by the Kansas City, Missouri Board of Parks, 1993 Master Plan. Any proposed river crossing may impact these parks and require coordination with agencies including the U.S. Coast Guard. Parks located adjacent to I-29 include West Terrace Park, on the west side of the Downtown Loop, Belvedere Park, at the Paseo Interchange, North Hills Park, north of Armour Road and Northgate Park, north of the I-29/I-35 split. I-29 also crosses Riverfront Parkway, the proposed parkway along Parvin Road, the proposed Line Creek Parkway, and Tiffany Springs Parkway. Impacts to adjacent neighborhoods and parks are possible with I-29/I-35 improvements.

  - ✓ *Constructability* – Constructability of identified roadway projects is essential to the roadway planning process. Constructability of roadway improvements will ensure that roadway physical features are capable of being achieved in a way that provides a safe driving environment for motorists during construction.

  - ✓ *Other Roadway Issues* – Additional study will be needed to identify the proper number of lanes on I-29 between I-35 and I-635. After traffic analysis was performed, level of service problems emerged beyond identified roadway improvements. Northland travel market analyses shows a heavy east-west movement, not destined for the Downtown Loop. The I-29 freeway serves the east-west movement in this section.

  - ✓ *Loop Study* – Once roadway projects were identified in the MIS, their impact on the central business district was identified. To better understand the impact of proposed roadway project, and to capture the full potential to improve land use and transportation Downtown, a Loop Study was performed. The Loop Study was performed at a planning level to ensure compatibility with the Preferred Strategy. Additional, more detailed land use and freeway loop analysis will be necessary.

Steering/Advisory Committee Members

Steering Committee Member List

First Name	Last Name	Organization
Mokhtee	Ahmad	Federal Transit
Dan	Bishop	City of Gladstone
David	Blackburn	City of Riverside
Thomas	Brandom	Clay County
Gene	Bruns	City of North Kansas City
Betty	Burch	City of Riverside
Bonnie	Cooper	City Council
John	Crawford	Port Authority of Kansas
Paul	Danaher	City of Kansas City
Dave	Edwards	FHWA
Ed	Ford	City of Kansas City
Alan	Gray	Jackson County
Betty	Knight	Platte County
Teresa	Loar	City of Kansas City
Stephen	Mahfood	MDNR
Ed	Quick	District 17
Dale	Ricks	MODOT
Joni	Roeseler	FTA
Harlan	Shaver, Jr.	City of Northmoor
Bill	Skaggs	District 31
Tommy	Thomson	KCATA
David	Warm	MARC
Russell	Widmar	KCMO Department of

Advisory Committee Member List

First Name	Last Name	Organization
Carol	Adams	
Jane	Beetem	Missouri Department of Natural Resources
Jennifer	Brandt	Congresswoman Karen McCarthy's Office
Ray	Brock	Curry Investment Company
Robert	Bromberg	KCMO Department of Public Works
Mark	Coulter	Representative from Sam Grave's Office
Jay	Dilingham	Northland Betterment Committee
Karen	Dolt	United Way of Kansas City
Terry	Dopson	KCMO Board of Parks & Recreation
Warren	Erdman	Kansas City Southern RR
Larry	Frevert	City of Kansas City
Pete	Fullerton	Platte County EDC
Charles	Garney	Northland Betterment Committee

Advisory Committee Member List (Continued)

First Name	Last Name	Organization
Ollie	Gates	KCMO Board of Parks & Recreations
Anita	Gorman	Northland Betterment Committee
Art	Gough	MARC Bicycle/Pedestrian Transportation
Stanley	Harris	KCMO Public Works Department
Mell	Henderson	MARC
Dick	Holwick	KTTR Services, Inc.
Lynn	Horsley	The Kansas City Star
Bob	Housh	Metropolitan Energy Center
Bob	Hurst	KCMO Planning & Development
Timothy	Kristl	Mitchell, Kristl, Lieber PC
Joe	LaMothe	Northeast Industrial Association
Glen	Leroy	Gould Evans Goodman
Pete	Levi	The Chamber of Commerce
Louise	Lloyd	FTA
Tom	McKenna	KCMO Aviation Department
Ron	McLinden	KCMO Department of Enviornmental
David	Miller	Hilton Flamingo Casino
Charles	Myers	Lathrop & Gage
Stuart	Nelson	MARC
Vicki	Noteis	City Planning and Development Department
Joe	Perry	KCMO Planning & Development Department
Cheryl	Reams	Missouri Department of Natural Resources
Ann	Robertson	Downtown Council
Matt	Roney	Representative from Senator Bond's Office
Joseph	Rudzik	Townsend Communications, Inc.
Tom	Rule	Rule and Company Appraisers
Merna	Saliman	Maple Woods Community College
Karen	Salsbury	Clay County EDC
Aaron	Schmidt	Platte County
Yvonne	Seckington	North Kansas City Hospital
Michele	Shields	Clay County EDC
Kite	Singleton	E. Chrichton Singleton FAIA, Inc.
Curtis	Stock	Northland Neighborhoods, Inc.
Sheila	Tracy	Northland Regional Chamber of Commerce
Bob	Watts	MARC Bike/Pedestrian
Steve	Wegner	Platte County
Roger	Wiebusch	US Coast Guard, DWRO Bridge Branch
Bruce	Wiggins	City Planning and Development
Dave	Winslow	Food for Thought
Ed	Wolf	City of Kansas City
John	Wollaston	Valley View State Bank
A. Marie	Young	Black Chamber of Commerce
Hugh	Zimmer	The Zimmer Companies

Roadway Improvements Technical Memorandum

August, 2000

1.0 Introduction

The purpose of this technical memorandum is to provide additional information about the potential roadway improvements being considered in greater detail as part of Strategy No. 4 (Highway Capacity Improvements). Based on a review of the various conceptual strategies and their performance, elements of each of the strategies were identified for further, more detailed definition and evaluation. These elements have been combined in various ways to constitute six unique and competing improvement alternatives:

- Alternative A (Base Condition)
- Alternative B (Low Cost)
- Alternative C (Partial Roadway)
- Alternative D (HOV)
- Alternative E (Low Cost with 1st Stage Fixed Guideway)
- Alternative F (Partial Roadway with 1st Stage Fixed Guideway)

Traditional roadway improvements, in terms of adding roadway capacity (i.e., number of lanes) or upgrading interchanges, are included in Alternatives B and C and are also combined with fixed guideway improvements in Alternatives E and F. This Technical Memorandum provides information on the definition of these roadway improvements.

2.0 Background

The conceptual definition of Strategy No. 4 was based on the transportation problems identified in the Northland~Downtown MIS Study Corridor. Strategy No. 4 identified two potential roadway improvement options – Improve Existing Facilities or Build New Facilities as defined in the Initial Strategies Definition Technical Memorandum.

2.1 Option A (Improve Existing Facilities)

Three existing roadway corridors were identified within Option A (Improve Existing Facilities) that could potentially improve travel across the Missouri River – I-29/I-35 (Paseo Bridge), US 169 (Broadway Bridge) and Burlington Avenue (Heart of America Bridge). Conclusions of the conceptual evaluation were as follows:

- **US 169 (Broadway Bridge)** - Due to the physical limitations of widening US 169 created by the Downtown Airport, the Missouri River and the adjacent rail yard, it was determined that adding lanes to this corridor was cost prohibitive. The most

promising means of improving the operations on US 169 is to relieve the congestion at its connection to the Downtown Freeway Loop at the 5th/6th Street Interchange.

- **Burlington Avenue (Heart of America Bridge)** – The Heart of America Bridge is currently under utilized due to the operational capacity limitations of the bridge's roadway approaches. In other words, the bridge can handle more traffic than the approach roadways can deliver. However, as an urban arterial with a series of signalized intersections, the capacity of Burlington Avenue is limited and has already been effectively maximized by MoDOT through signal coordination. No additional roadway improvements to this corridor were recommended.

- **I-29/I-35 (Paseo Bridge)** – I-29/I-35 can potentially be widened with additional travel lanes to add capacity across the Missouri River into Downtown Kansas City. It was recommended that adding lanes to this corridor be investigated further.

2.2 Option B (Construct New Facilities)

The preliminary evaluations of the conceptual strategies determined that constructing new roadway corridors across the Missouri River would not be the most efficient or cost-effective solution to addressing the current and projected traffic problems crossing the river. These considerations included a new river crossing upstream (west) of the Broadway Bridge, or a new crossing between the Paseo Bridge and the Chouteau Bridge. Based on the inability of these concepts to either improve the roadway system's operations or be implemented inexpensively, this option was eliminated from further consideration as discussed in the Initial Strategies Evaluation Technical Memorandum.

3.0 Description of Roadway Improvements

The candidate roadway improvements consist of adding capacity to the I-29/I-35 and US 169 Corridors. Plan plates of the roadway improvements described below are attached at the end of the memorandum.

3.1 I-29/I-35 Corridor

Based on the operational analyses of the existing I-29/I-35 roadway under both current and 2020 traffic conditions, it was determined that two types of roadway improvements to this corridor are needed – mainline improvements and interchange improvements. Mainline improvements entail adding through travel lanes by widening the existing roadway section. Interchange improvements represent more localized, spot upgrades to address isolated problems that impact the system's overall capacity.

- **Mainline Improvements** – I-29/I-35 currently consists of primarily two through lanes in each direction from US 169 to the Downtown Loop. However, at the I-29/I-35 Interchange, I-29/I-35 is reduced to one through lane in the south direction. In general, I-29/I-35 south of the I-29/US 169 Interchange has insufficient mainline capacity to efficiently serve the projected travel demands. Additional through lanes are needed between US 169 and the Downtown Loop, including the crossing of the Missouri River. Features of these improvements are as follows:

Lane Configuration	Add two general-purpose lanes (one northbound and one southbound) between the I-29/US 169 Interchange and the I-29/I-35 Interchange to provide a six-lane section. Also, add four general-purpose lanes (two northbound and two southbound) between the I-29/I-35 Interchange and the Downtown Loop to provide an eight-lane section. From a system perspective, one additional lane in each direction would be added from US 169 and another additional lane in each direction would be added from I-35, thereby providing eight through lanes into the Downtown Loop. Eight lanes into and out of the Loop result in two-lanes into and out of each leg of the Loop. Auxiliary lanes would be provided between: ✓ North Oak Trafficway and I-35 ✓ I-35 and Route 210 ✓ Bedford Avenue and Levee Road ✓ Front Street and Paseo Boulevard
Roadway Section	Between the I-29/US 169 and I-29/I-35 Interchanges, the additional roadway lanes would be added to the outside in each direction. The open median would be closed with a median barrier and full-width inside shoulders would be provided. South of the I-29/I-35 Interchange, the additional lanes would also be provided outside of the existing lanes. The existing median barrier in this segment would be maintained and the existing pavement would be restripped to provide full-width inside shoulders. South of the I-29/I-35/Route 210 Interchange, retaining walls could be necessary to avoid direct impacts to adjacent land use.
Missouri River Crossing	The existing Paseo Bridge would be converted to one-way traffic and would provide four southbound lanes. A new bridge immediately adjacent to and downstream of the existing bridge would be constructed to provide four northbound lanes. Additional deck width would be required for the northbound Front Street on-ramp. The alignment for I-29/I-35 would transition back to the existing centerline both north and south of the crossing.
Issues	✓ Constructability ✓ Maintenance of traffic during construction ✓ Provisions for potential future widening of I-35 ✓ Extent of reusable existing I-29/I-35 pavement

- **Interchange Improvements** – There are a number of interchanges along the I-29/I-35 Corridor with deficient operations. The majority of these are located within the limits of the mainline improvements. These deficiencies are the result of either a lack of capacity at the individual interchange, or too close spacing with adjacent interchanges. In some cases, due to the close spacing of the access points, it is recommended that an existing interchange be eliminated. In these cases, access would be maintained through the adjacent interchanges. Features of these improvements are as follows:

I-29/Tiffany Springs Interchange	The existing interchange consists of a diamond-type interchange. Existing problems at this interchange result from high traffic volumes for the north to east movement in the morning and the west to south movement in the evening. Also, the close proximity of the Ambassador Drive intersection immediately to the east of the interchange impedes traffic flow at the eastern ramp terminal. Earlier planning by the City of Kansas City, Missouri showed loop ramps in the northwest and southeast quadrants, but land development has subsequently occurred that prohibits the construction of these loops. Consequently, it is recommended that a single-point interchange be constructed at this location with dual left-turn lanes. To account for the traffic flow between I-29 and Ambassador Drive, it is suggested that the interchange configuration be modified such that the north to east movement and the north to Ambassador Drive movement be located at the Tiffany Springs/Ambassador Drive Intersection.
I-29/US 169 Interchange	This interchange marks the northern point for the additional lane to be added to I-29 in each direction. These lanes would be added through the continuation of the south to east ramp and its complement (i.e., west to north ramp). Improvements to this interchange would entail providing two through lanes along northbound US 169. This would be accomplished by providing a continuous lane on the outside of northbound US 169 for the west to north ramp. This lane would then drop at the US 169/56th Street Interchange – the next interchange to the north.
I-29/Vivion Road Interchange	Due to the close proximity of this interchange to US 169 and the access available at the next interchange to the east (i.e., I-29/North Oak Trafficway Interchange), it is recommended that this interchange be closed. By doing so, the operations along I-29 would be improved through the elimination of several short, deficient and unsafe weave sections.
I-29/North Oak Trafficway Interchange	With the potential closure of the Vivion Road Interchange, full movements would need to be provided at this location. Currently, the interchange movements in the northwest quadrant are provided by slip ramps located along Vivion Road a relatively short distance to the west. Space limitations exist due to the close proximity of Vivion Road, which is located parallel to and a short distance north of I-29. It is recommended that this interchange be replaced by a full single-point diamond interchange. This reconfiguration would displace those businesses currently located in the southwest corner of the North Oak Trafficway/Vivion Road intersection. Moving the intersection to the north,

	requiring a minor relocation of Vivion Road, could provide greater distance between this intersection and the interchange.
I-29/Davidson Road Interchange	This interchange would be maintained in its current configuration and location.
I-29/I-35 Interchange	The configuration of this interchange would be maintained, but some improvements would be necessary due to conflicts with ramp bridge substructure elements. Because of the widening of the I-29 roadway, from its current configuration to three through lanes in each direction, the I-29 southbound to I-35 northbound ramp bridge would need to be replaced. From a system perspective, the three through lanes in each direction from I-29 would combine with two through lanes in each direction from I-35 to create a ten-lane section between this interchange and Route 210. The outside lanes for this section would be auxiliary lanes and would terminate and begin at the I-29/Route 210 Interchange.
I-29/Parvin Road Interchange	Due to the close proximity of this interchange to the I-29/I-35 Interchange and the availability of access at the I-29/Davidson Road Interchange or the I-35/Antioch Road Interchange, it is recommended that the southbound off-ramp and the northbound on-ramp be closed at this location. By doing so, the operations along I-29 would be improved through the elimination of several short, deficient and unsafe weave sections. This interchange would therefore be converted to a half-diamond type interchange with ramps to and from the south.
I-29/Route 210 Interchange	This interchange currently consists of a tight clover-leaf type interchange with short weave sections on I-29 and Route 210. The Route 210 crossing is highly skewed with development in the northwest and southeast quadrants that prohibit the expansion of the interchange. Alignment adjustments to reduce the crossing's high degree of skew are not prudent. Given these constraints, it is recommended that this interchange be converted to a diamond-type interchange. This interchange would be atypical due to the skew -- the southbound and northbound ramps would share the same ramp terminal intersection. This intersection would be located underneath the I-29 overpass and special lighting and sight distance considerations would be required. Driver expectancy would also be an issue that would need to be addressed. This configuration would introduce three traffic signals along Route 210.

I-29/16th Avenue Interchange	This interchange would be maintained in its current configuration and location.
I-29/Bedford Avenue Interchange	This interchange would be maintained in its current configuration and location. Due to its close proximity to Levee Road, minor adjustments should be made to the ramp nose locations to maximize the distance between the interchange ramps.
I-29/Levee Road Interchange	This interchange would be maintained in its current configuration and location. Due to its close proximity to Bedford Avenue, minor adjustments should be made to the ramp nose locations to maximize the distance between the interchange ramps.
I-29/Front Street Interchange	Several optional interchange improvements have been identified at this location as part of the ongoing planning for the Front Street improvements and the Riverfront Development. Issues that need to be addressed at this location include 1) the close spacing of this interchange and the Paseo Boulevard Interchange to the south, 2) the ramp grades for better service to the high number of trucks, and 3) better continuity for Front Street for improved system access from the Chouteau Trafficway into Downtown via the new Grand Avenue Viaduct. One optional interchange would be a tight diamond-type interchange with Front Street reconfigured over I-29. The southbound off-ramp nose would need to be located immediately south of the existing Paseo Bridge. The northbound on-ramp would extend onto the new bridge for the northbound I-29 lanes. The ramps to and from the south would require bridges to span the nearby rail facilities.
I-29/Paseo Boulevard Interchange	This interchange is deficient primarily due to the current lane shifts required for I-29. It is recommended that the priorities between I-29 and Paseo Boulevard be switched such that I-29 has priority and better continuity. With this arrangement, Paseo Boulevard traffic must exit or enter I-29. Due to the close proximity of Front Street, auxiliary lanes would be necessary between this interchange and the I-29/Front Street Interchange to the north.
Downtown Loop	The Downtown Loop demarcates the terminus of I-29. Through lane continuity for the mainline I-29 would be provided with two-lane connections to the northern and eastern legs of the Downtown Loop. Due to the widening of the I-29 mainline, several of the overpass bridges in the northeast corner of the Loop would need to be replaced and lengthened. In addition, it is recommended that the two southerly ramps to Independence Avenue be closed to improve the freeway operations.

3.2 US 169 Corridor

Based on the operational analyses of existing US 169 under both current and 2020 traffic conditions, it was determined that operational improvements could most cost-effectively be provided by improving the connection of this corridor with the Downtown Loop. With its current configuration, the operations of US 169 over the Missouri River is controlled by the limited capacity of the US 169/5th and 6th Street Interchange. The existing four-lane capacity of the US 169 roadway is underutilized due to the inability of the Downtown Loop connection to serve the incoming traffic. In particular, a high percentage of the US 169 traffic is destined to I-35 south in the morning and originating from I-35 north in the evening. By separating the US 169 traffic destined to or originating from Downtown from the I-35 turning traffic, the existing 5th and 6th Street intersections would operate better. In addition, Kansas City, Missouri is moving forward with intersection improvements that will improve the efficiencies of these intersections in their current configurations. Two optional improvements have been identified – Option 1 (Fly- Over Ramps) or Option 2 (Three-Level Diamond).

- **Option 1 (Fly-Over Ramps)** – This option entails adding fly-over ramps for the US 169 to I-35 movement to the existing interchange. The southbound US 169 to southbound I-35 ramp would be added with a connection to I-35 south. An auxiliary lane in the southbound direction would be needed between the I-70 on-ramp and the 12th Street off-ramp to maintain lane continuity. In the northbound direction, the fly-over ramp would have a left side diverge with a right side connection to US 169 near the location of toll plaza platform. The northbound fly-over ramp would provide one of the US 169 lanes across the existing Broadway Bridge. The other US 169 travel lane would serve the northbound traffic passing through the existing 5th Street intersection.

- **Option 2 (Three-Level Diamond)** - This option would consist of constructing the US 169 through travel lanes on structure over the existing 5th and 6th Street intersections. Connections to existing US 169 immediately south and north of the existing interchange would be provided. With this option, turning traffic would continue to utilize the existing interchange ramps and through traffic, destined to or originating from Downtown, would utilize the top level of the interchange, thereby being separated from the turning traffic.

NORTHLAND

DOWNTOWN

MAJOR INVESTMENT STUDY

Roadway Improvement Plan Plates

Problem Definition
Technical Memorandum

March, 1999

1.0 MIS Background and Context

The Kansas City Area Transportation Authority (KCATA) and the Missouri Department of Transportation (MODOT), in association with the Mid-America Regional Council (MARC), have initiated the Northland~Downtown Major Investment Study (MIS). The purpose of this study is to develop long-range transportation solutions for the travel corridor between the Kansas City International (KCI) airport area and downtown Kansas City, Missouri. As part of the MIS, an understanding of the transportation-related problems that need to be addressed by the MIS has been formulated. This understanding has been developed based on a framework of study goals and objectives. These were derived from MARC's regional goals developed in association with the region's Long-Range Transportation Plan, as they may apply to the KCI-Downtown travel corridor. A summary of the basic problems identified within the Study Area is presented below followed by more detailed and specific findings.

Public input and comment have been instrumental to the development of this problem definition. Comments offered by the general public and by community leaders have been incorporated into the problem definition to reflect the experiences of those that live in or travel through the corridor.

To help guide the study and to ensure that the full range of concerns are addressed, two ad-hoc committees were established specifically for this MIS. The purpose of the Steering Committee, comprised of community officials and representatives in policy-level positions, is to make policy-type recommendations to the study sponsors. Also convened for this MIS was an Advisory Committee, comprised of persons with mixed technical expertise. This committee's role involves reviewing and commenting on information provided by the study team including technical data and methods upon which study recommendations are based. During the investigation of the Study Area's problems, insight and direction from these committees were crucial to the development of the problem understanding. Committee review and coordination included the organization of the goals and objectives for the Northland~Downtown MIS from which problems were assessed and solutions will be evaluated.

The Study Area is defined as the area surrounding I-29 and other facilities that serve the KCI to downtown Kansas City, Missouri travel market. This area includes the three downtown Missouri River roadway bridges – Broadway (US 169), Heart of America (Route 9) and Paseo (I-29/I-35). Consistent with FOCUS, the comprehensive master plan for Kansas City, Missouri, the urban core is defined as the combined and contiguous downtown Kansas City, Crown Center and Country Club Plaza areas. Downtown Kansas City is defined as the central business district generally bounded by the I-70 and I-35 freeway loop.

2.0 Basic Problems

The transportation-related problems currently experienced or projected within the Study Area are symptoms of several basic issues specific to the Northland. These issues are summarized as follows:

- **Changing Travel Markets** – Cross-river travel destined for locations outside the Northland~Downtown MIS Study Area.
- **Increased Intra-Northland Travel** – Short trips using/affecting highway system.
- **Aging and Outdated Transportation Infrastructure** – River bridges, poor pavement, obsolete design.
- **Limited Non-Highway Mobility Options** – Transit, bicycle, pedestrian.
- **Land Use and Development Patterns** – Decentralized development patterns, dependence on the automobile and jurisdictional issues.
- **Traffic Congestion** – Increasing congestion crossing the Missouri River.
- **Inefficient Use of Transportation System** – Need for better traffic-flow management.

Identification of transportation-related problems is further shown in Exhibits 1 through 11 at the end of this technical memorandum. The exhibits identify future traffic demand, level of service, roadway design, bridge condition, pavement condition and vehicle accident rates. The exhibits help identify the basic problems in the study area and compliment the problem definition.

3.0 Travel Markets and Patterns

Many of the basic problems experienced in the corridor, both today and in the future, are direct products of the transportation system's response to the corridor's commuter-oriented travel demands. Evidences of mobility, travel efficiency and access problems are typically the symptoms of the transportation system's responsiveness to the area's travel markets (i.e., where people travel to and from).

In the case of the Northland~Downtown Study Area, the travel markets show a defined pattern of trips to and from the Study Area and downtown Kansas City. The growth in travel across the Missouri River will be significant. Much of the increased work-oriented travel across the river is expected to occur in circumferential patterns – from suburb to suburb. Growth in trips traveling to or through downtown will also be significant. Consequently, current congestion and mobility problems on the downtown bridges will continue to worsen in the future. Between 1990 and 2020, total daily trips across the river are expected to increase by 42% -- an annual compound growth rate of slightly over 1%.

By knowing the root causes of the basic problems experienced in the transportation system, planners can more readily identify appropriate solutions. Observations gained from the market analyses relevant to potential solutions include the following:

- There is a defined and growing travel market to the urban core from the Northland. The travel demands associated with this market lead to the congestion problems crossing the Missouri River. ***Solutions that provide improved travel capacity between the Northland and the urban core would relieve the river crossing's existing and future mobility problems***.

- Daily travel across the Missouri River is growing. Cross-river trips destined for areas outside of the urban core, which must travel through downtown due to the limitations of the existing infrastructure, contribute to the congestion across the river in the downtown area. ***Solutions that address the mixture of cross-river trips destined to areas inside or outside of the urban core would mitigate the river crossings' capacity problems in the downtown area.***

- With the business and development growth potential of the area, travel within the Northland itself is anticipated to grow significantly. The Northland's east-west mobility problems, which have been documented in earlier planning studies, reflect this desire for internal Northland travel. These problems will continue to worsen as Northland travel increases. ***Solutions to downtown-oriented commuter problems will also need to better serve shorter intra-Northland travel.***

4.0 Transportation Goals and Objectives

MARC's established regional transportation goals and objectives, along with FOCUS and other adopted goals of the sponsoring agencies, collectively provide the basis for the assessment of the travel corridor's existing and future transportation-related problems. The goals and objectives framework for this MIS focuses on the regional issues of System Preservation, Personal Mobility and Quality of Life; Land Use and Development; Regional Economy; Safety; and System Management and Efficiency. The effectiveness of the existing and planned transportation system in accomplishing the goals for each of these issues determines the extent of the need for transportation improvements. Similarly, the effectiveness of the transportation solutions in accomplishing these goals and relieving the problems is a consideration in the assessment of the potential solutions.

5.0 Changing Travel Markets

One of the significant changes in the travel patterns of the Northland is the growing cross-river suburban to suburban travel. Much of the increased work travel across the river is expected to occur in circumferential patterns. But due to the constraints of the existing roadway network, a significant portion of these trips must travel through the downtown area in route to their suburban destinations. This suburban-to-suburban travel market must mix with travel between the Northland and downtown. This mixture of trips contributes to the congestion across the Missouri River bridges and the congestion at the bridge approaches.

- Of the peak hour southbound traffic approaching the Broadway/5th Street intersection in the a.m., 45% of the vehicles turn west onto southbound I-35. This percentage of the total approach volume is expected to grow in the future.

- Of the peak hour northbound traffic crossing the Broadway Bridge (US 169) in the p.m., approximately 38% of the vehicles come from northbound I-35. This percentage of the total bridge traffic volume is expected to grow in the future.

- Due in part to the high volume and high percentage of turning traffic, the current and projected operations of the Broadway intersections with 5th and 6th Streets are unacceptable, resulting in considerable traffic delays. Congestion at the intersections causes a backup of traffic onto the Broadway Bridge during the a.m. commuter rush period, and a backup onto the downtown street system in the p.m. period.

- In response to these unacceptable operations at the 5th and 6th Street intersections, the City of Kansas City and MoDOT have convened a task force, along with local businesses, to identify solutions to the intersection problems. Short term solutions have been identified including signal upgrades, roadway approach improvements, access management, better signal coordination, and potential system management measures such as variable-message signs.

6.0 Increased Intra-Northland Travel

Travel to and from the Northland is expected to grow significantly between now and 2020 (see Exhibits 1 and 2). Most of this growth will consist of relatively short trips within the Northland. Travel beginning and ending in Platte or Clay Counties is anticipated to grow annually at a rate of 2.1% -- a pace faster than the overall regional rate of 1.4%. This increased travel within the Northland will continue to tax the existing arterial street system and the inter-connection points between the local street system and the region's freeway system.

- East-west (non-radial) travel is expected to increase more rapidly than north-south travel. Given the predominant land use patterns of the Northland, it may be assumed that the vast majority of these new trips will be made on the area's highway system.

- Improvements to the Northland's arterial street system, including east-west roadways that cross and interact with the highway network, would probably serve many travelers more directly than improvements to the interstate system. Arterial system improvements would help preserve the freeway system's capacity for longer distance travel.

7.0 Aging and Outdated Transportation Infrastructure

The condition status of the existing transportation elements in the Northland which serve the KCI-Downtown travel market – pavement, bridges and public transit – suggests that future investments in the system could relieve the aging state of the system (see Exhibits 7 through 10). Preservation of the system would entail replacing or rehabilitating the existing system in association with, or as a direct result of, future capital improvements.

- Several segments along I-29, US 169 and Route 9 warrant major pavement rehabilitation or replacement before 2020, the most pressing of these being Route 9 between US 169 and Armour Boulevard.

- Of the three existing downtown roadway bridges – Broadway (US 169), Heart of America (Route 9) and Paseo (I-29/I-35) – the Broadway and Paseo structures are in the greatest need for repair. Currently planned painting and rehabilitation projects by MoDOT for these two bridges will extend their service lives, but replacement or major rehabilitation of these structures will be likely by 2020.

- The current average age of the KCATA bus fleet is around six to seven years. Though a systematic upgrading of the fleet is not necessary at this time, efforts to maintain the fleet's condition status will need to be continued by the KCATA.

8.0 Limited Non-Highway Mobility Options

The regional goal of personal mobility deals with providing transportation opportunities for the promotion of the general welfare of the public. Measures used to evaluate problems relating to the Northland's mobility include an assessment of the existing transportation system's services and access to activity centers.

- The KCATA's Comprehensive Service Analysis has identified that since the middle of the last decade, transit ridership has declined system wide. This decline is attributed to cuts in service and diversifying regional travel patterns. In general, bus transit usage in the Northland has declined at a slightly greater rate than the system as a whole. In March, 1995, KCATA routes within the Study Area attracted a total average weekday ridership of 1,248 – 2.6% of all riders on The Metro. These same routes account for 5.4% of weekday bus-hours and 7.5% of weekday bus-miles.

- Of the Study Area's bus routes, only two routes produce ridership in excess of the system's average of 26 passengers per hour.

- The existing downtown radial-oriented transit service concept causes cross-town travel to be inefficient and inconvenient. There is currently a lack of crosstown service and service that focuses on the Northland's activity centers. The lack of an efficient and interconnected east-west arterial street system affects the efficiency of crosstown transit service.

- There are no efficient or safe pedestrian/bicycle facilities, current or planned, for crossing the Missouri River between the Northland and downtown. Furthermore, there is a general lack of pedestrian/bicycle facility connectivity and continuity within the Study Area. This includes a lack of pedestrian facilities in support of the area's transit services.

9.0 Land Use and Development Patterns

The Northland is socially and economically diverse and represents Kansas City, Missouri's most significant opportunity for growth with over 75% of all the vacant land remaining in the city limits. The Northland epitomizes both the opportunities and problems associated with a decentralized pattern of development. Primarily associated with major transportation corridors and dependence on the automobile, recent growth within the Study Area has occurred in a linear fashion along the freeway corridors – I-29 and US 169. The unique natural terrain of the

Northland has also contributed to this historical growth pattern as north-south oriented streams and ridges characterize the region.

- The typical suburban development pattern of the Northland has resulted in transportation-related problems given that major activity centers are strung along major thoroughfares, often without access management and without connections among them.

- Employment centers at the airport are not connected to retail centers south and east, and commercial centers are not efficiently connected to one another.

- Development in the Northland is predominantly oriented to the automobile, with public transit, bicycles and pedestrian systems not fully developed. Lack of connections, alternative routes, access management and facilities for other modes of travel result in increased congestion at highway interchanges.

- The approved comprehensive plan for the Northland in FOCUS proposes to improve connections between activity centers for all modes of travel, encourage less auto-oriented development and higher densities to increase the potential for public transit. The plan also places a higher priority on infill development and discourages the continued sprawl to the north.

- In the near term, the area's transportation infrastructure can not keep pace with the mobility and connectivity demands as the area continues to develop.

10.0 Traffic Congestion

As a natural transportation barrier, the capacity of the transportation system across the Missouri River is one of the limiting factors for system's overall level of service between the Northland and downtown (see Exhibits 3 through 6). Transportation investments in the system's cross-river capacity may accomplish a number of goals. Congestion-relief investments can positively impact the region's economy through improved cross-river linkages and connections between the region's activity centers. As a natural, physical barrier between the Northland and downtown Kansas City, the river can also be a barrier to the integrated economic synergies of the region. The health and safety of the traveling public is also of paramount concern in the planning, implementation and operation of transportation services and facilities (see Exhibit 11). Additional opportunities to improve the transportation system's safety arise when major mobility and congestion-relief improvements are implemented.

- Considering the capacity of all three downtown roadway bridges collectively, there is sufficient total capacity to serve the travel demand for the a.m. and p.m. peak periods for both current and 2020 conditions. However, based on the current distribution of vehicles crossing the three bridges, neither the Broadway nor Paseo Bridges have sufficient capacity to efficiently serve their respective current or projected (2020) traffic volumes.

- The Heart of America Bridge has excess capacity available, but its capacity is greater than the ability of the approach roadways to deliver (i.e., Burlington Avenue to the north and the downtown street system to the south). The capacity of Burlington Avenue is limited due to its series of traffic signals and cross streets.

- The Broadway Bridge has greater carrying capacity than what the Broadway and 5th/6th Street intersections can deliver. The 5th/6th Street intersections control the operations and throughput of the Broadway Bridge.

- Based on a review of MoDOT accident records, there are several roadway segments with accident experiences in excess of the statewide average for a similar facility. Though the majority of these areas are located in areas with capacity and associated congestion problems, a few are in isolated areas. Elements that contribute to a roadway's safe operation include the physical makeup of the system (i.e., roadway section, alignment and degree of access control) and its operational characteristics. Higher accident areas are typically located in roadway segments with congested operational conditions. There are several segments or areas along I-29 and US 169 with roadside conditions or alignments that may be contributing factors to accidents.

- The safety record of the KCATA is well within an acceptable range for transit operators. The KCATA averages approximately 43 vehicular accidents per million vehicle miles, and this rate has been declining over the years as a number of safety programs have been implemented. In a recent on-board bus survey completed by the KCATA, over 80% of the respondents from the Northland indicated satisfaction with bus stop safety. Safety and security are not perceived to be a problem.

11.0 Inefficient Use of Transportation System

One of the primary objectives of transportation planning in the Kansas City Metropolitan Area is the prevention or relief of traffic congestion that not only causes delay and inconvenience but contributes to inefficiencies in the region's economy. Measures used to gage the transportation system's inefficiencies are typically travel delay, travel speed and other performance indices. Delays in travel result when travel demands exceed the capacity or ability of the system to efficiently serve those demands. Current and projected operational inefficiencies of the existing roadway system are evident through congested travel conditions resulting in reduced travel speeds and longer travel times.

- As one would expect, the Northland roadway system's traffic volumes increase closer to downtown Kansas City and the Missouri River.

- North of the I-635 Interchange, operational problems along I-29 are limited to isolated interchange areas with limited crossroad capacities, such as Tiffany Springs Parkway. Similarly, US 169 north of I-29 has sufficient capacity to meet existing and future travel demands.

- South of the I-635 Interchange area, both US 169 and I-29 have systematically insufficient capacity for 2020 traffic volumes. For the most part, these deficiencies are due to a lack of through-lane capacity.

- Operations at several interchanges exacerbate the mainline operational deficiencies south of the I-635 area. These interchange problems consist of through lane imbalances, ramp volumes exceeding ramp capacities and functional obsolescence. Operationally deficient interchanges include:

- ✓ I-29/I-635 Interchange
- ✓ I-29/US 169 Interchange
- ✓ I-29/North Oak Trafficway Interchange
- ✓ I-29/I-35 Interchange
- ✓ I-29/Route 210 Interchange
- ✓ I-29/Front Street Interchange
- ✓ US 169/Route 9 Interchange

- The connection of Broadway (US 169) to I-70 and the downtown street system has insufficient capacity and causes considerable traffic backup and delay.

- Intersection capacity deficiencies at the intersection of Armour Boulevard and Burlington Avenue (Route 9) limit the throughput capacity of Route 9.

- The recent on-board survey completed by the KCATA suggests that those who currently use The Metro in the Northland are generally pleased with the system's performance. Service frequency, bus fare, on-time performance and system routing aspects all received satisfactory responses by at least 75% of the riders.

- Though the KCATA is generally satisfying its current patronage, other performance indicators would suggest that revisions to the system's design concept may be warranted to better serve the Northland. For the Northland bus routes within the Study Area, the weekday passengers per hour and passengers per mile figures are well below the system-wide averages.

Preferred Strategy
Alternative F
Partial Roadway with 1st Stage Fixed Guideway
Technical Memorandum

October, 2001

1.0 Introduction

The consideration of the best improvement strategy for better transportation system linkage across the Missouri River through the 2020 design year includes an evaluation of the improvement's effectiveness in accomplishing the goals of the study, including:

- ✓ System Preservation
- ✓ Personal Mobility and Quality of Life
- ✓ Land Use and Development
- ✓ Regional Economy
- ✓ Safety
- ✓ System Management and Efficiency

To address all these goals, a combination of inter-modal transportation improvements is recommended, as contained in Alternative F (Partial Roadway with 1st Stage Fixed Guideway).

2.0 Pedestrian Recommendation

The recommended preferred pedestrian strategy includes:

- Support construction of a bike/pedestrian crossing on the existing Heart of America Bridge, consistent with the MARC Bicycle and Pedestrian Advisory Committee and MoDOT plans.
- Replace the Heart of America bike/pedestrian crossing with a new pedestrian crossing over the Missouri River in combination with the planning, design and construction of a fixed guideway transit bridge crossing.
- Provisions for pedestrian and bicycle access across I-29 as part of future interchange improvements at Front Street, Route 210, Davidson, North Oak Trafficway, US 169 and Tiffany Springs Parkway.

3.0 Transit Recommendation

The preferred transit strategy for the Northland is **1st Stage Fixed Guideway** including:

- A **fixed guideway**, including either Bus Rapid Transit or Light Rail Transit, from Downtown to the vicinity of I-29 and US 169 utilizing an exclusive Missouri River

bridge located east of the Heart of America bridge. A preferred route generally following Burlington and North Oak Trafficway was identified but further study of this segment will be necessary to identify guideway technology, route location and features.

- **Expanded bus service** in the Northland including additional transit centers, coordinated park-and-ride lots and expanded bus service for intra-Northland travel.

- An extension of **fixed guideway to the KCI Airport** should be planned for implementation in the longer term. The KCATA, City of Kansas City and MARC should take steps in the short-term to further refine the Line Creek Conceptual Alignment, to preserve and acquire the right-of-way, and to develop station area land use plans and policies to enhance ridership potential.

- Update to the City of Kansas City **Major Street Plan** indicating the conceptual fixed guideway alignment from Downtown to KCI.

4.0 Roadway Recommendation

The preferred roadway strategy for the Northland consists of **Partial Roadway** improvements including:

- **Transportation System Management projects** which include MoDOT's Intelligent Transportation System SCOUT project. Such projects include implementation of ITS along the US 169 and Route 9 corridors into Downtown. Other low-tech ITS improvements such as variable message signing for travel route decision-making could be expedited and implemented immediately.

- **Transportation Demand Management projects** using regional control measures which include policies and tools to decrease traffic by reducing the need to make a trip or by allowing the trip to be made outside of a congested time period. Mid-America Regional Council's transportation demand management policies and tools should be implemented in the Northland~Downtown Corridor.

- **5th/6th Street and Broadway Improvements** by the City of Kansas City and MoDOT entailing access management and signalized intersection improvements. These improvements are currently being implemented and should move forward into construction.

- **5th/6th Street and Broadway Flyover Ramps** between the Broadway Bridge and I-35 on the west side of the Downtown freeway loop. The next step would entail preliminary engineering and constructability studies for the improvements.

- **I-29 Interchange Improvements**, entailing the reconstruction and upgrading of four existing interchanges. These interchanges warrant improvements with or without the I-29 Mainline Improvements. The next step would entail public involvement, preliminary engineering, in association with the mainline improvements, and environmental studies. (Other interchanges would be improved as part of the mainline improvements.)

- I-29/I-35/Downtown Loop Access (Charlotte and Harrison)
- I-29/I-35/Route 210 Interchange
- I-29/North Oak Trafficway Interchange
- I-29/US 169 Interchange

- Improvement of the **I-29/Tiffany Springs Interchange**, entailing the reconfiguration of the interchange to better serve traffic. The next step would entail preliminary engineering and environmental studies.

- **I-29 Mainline Improvements**, including primarily 8 through lanes plus auxiliary lanes and improved shoulders; new and improved access into Downtown via Charlotte and Harrison; further considerations of improvements to the Loop, and a new parallel River bridge. Additional I-29 highway lanes would be provided from US 169 into Downtown. Access into and out of Downtown would be enhanced (i.e., Charlotte and Harrison Frontage Roads) and further considerations would be given to enhancements to the north and south legs of the Loop, such as decking over the freeway and/or access management improvements. The next step would entail more detailed study of the Loop improvements, preliminary engineering, environmental studies, public involvement activities and coordination with the I-70 Major Investment Study.

    - I-29/I-35/Paseo Boulevard Interchange
    - I-29/I-35/Front Street Interchange
    - I-29/I-35/Levee Road Interchange
    - I-29/I-35/Bedford Avenue Interchange
    - I-29/I-35/16th Avenue Interchange
    - I-29/I-35/Parvin Road Interchange
    - I-29/I-35 Interchange
    - I-29/Davidson Road Interchange
    - I-29/Vivion Road Interchange

- Continue to consider and evaluate Joint Development Opportunities as part of the improvements, such as space provisions for fixed guideway as part of the North Oak Trafficway Interchange, or provisions for pedestrians, or park-and-ride lots, within or outside of MoDOT right-of-way, in conjunction with the area's transit service.

5.0 Justification

Alternative F (Partial Roadway with 1st Stage Fixed Guideway) provides the combination of both pedestrian, transit and roadway improvements which best serve the Northland for the following reasons:

- **System Preservation** – Alternative F would expand the existing bus transit system in the Northland. Much of the I-29 Corridor is in need of rehabilitation/resurfacing and the roadway improvements address these needs.

- **Personal Mobility and Quality of Life** - Alternative F would enhance the personal mobility and the quality of life within the Northland~Downtown Corridor and into the

Central Business Corridor, in combination with the Central Business Corridor Community Plan through:

- ✓ Improved access to the transit system, particularly with the expanded bus service combined with the fixed guideway improvements.
- ✓ Improved east-west mobility.
- ✓ Enhanced transportation connections across the Missouri River with enhanced access into Downtown.
- ✓ New connections for non-motorized modes.

Should fixed guideway, including light rail transit, be implemented within the region, Northland light rail transit, when combined with light rail south of the river, provides partial implementation for a regional rail system that would serve all residents. Alternative F attracts the highest number of transit riders in the Corridor.

Roadway improvements in Alternative F provide a substantial reduction in vehicle hours traveled to Northland motorists. As a result, operational improvements in the roadway system are realized with improved travel times, improved travel speeds and reductions in motorists delay. Reductions in vehicle miles traveled are greatest for Alternative F as well. The maximum reduction in vehicle miles traveled translates to the greatest benefits for air quality and other quality of life factors.

- **Safety** - Alternative F would provide safe and secure transit service. Alternative F would bring the I-29 mainline and interchanges up to current design standards providing the highest safety. This in turn would reduce accidents in the Northland and provide improved emergency vehicle response.

- **Land Use and Development** – Alternative F would promote and facilitate the continued fulfillment of the established goals of FOCUS – the comprehensive land use plan for the City of Kansas City, Missouri, in addition to land use plans for other communities in the Northland. Better and enhanced access into Downtown would be provided and a framework for further considerations of urban design treatments, such as decking, would be created for the Loop.

- **Regional Economy** – Alternative F would provide fixed connections between North Kansas City and Downtown, thereby further linking the area's economic centers. Each of these alternatives would be expanded in the future to further connect the economies of the Northland and Downtown. Alternative F provides the greatest person capacity potential across the Missouri River than any other alternative.

Noise Assessment
Technical Memorandum

November, 2000

1.0 Introduction

The following technical memorandum provides a summary of the noise assessment of proposed improvements. The basic goals of FHWA, FTA and MODOT noise criteria are to minimize the adverse noise impacts on the community from construction and operation of highway and transit projects and, where necessary and appropriate, to provide feasible and reasonable noise abatement. This report uses the equivalent sound level, L_{eq}, to assess impacts from Alternatives A, B, C, E and F. L_{eq} is the preferred descriptor to describe continuous sounds, such as noise from relatively dense highway or roadway traffic. An outdoor traffic noise level equal to or higher than 66 dBA, L_{eq} (1-hour), is identified by the FHWA and Missouri Department of Transportation as the impact level at which abatement should be considered.

2.0 Methodology

Project-generated noise levels were estimated and potential impacts at sensitive receptors were assessed in accordance with Federal and MoDOT Guidelines. The noise assessment evaluated potential impacts for the alternatives listed below.

- A – Base Condition
- B – Low Cost
- C – Partial Roadway
- E – Low Cost with 1st Stage Fixed Guide-way
- F – Partial Roadway with 1st Stage Fixed Guide-way

Alternatives A, B and C were evaluated for potential traffic noise along segments of I-29, US 169 and North Loop. Alternatives E and F included traffic noise impacts and LRT noise impacts associated with the Fixed Guideway that would run along Route 9. The noise assessment was prepared by performing the tasks listed below:

Task 1: For each alternative existing and future peak hour traffic volumes for segments identified along I-29, US 169, North Loop and Route 9 were utilized to estimate traffic noise levels and to determine the distance to 66 dBA noise contour adjacent to each segment.

Task 2: For Alternatives E and F, data on LRT operations were used to estimate maximum hourly train L_{eq} noise level. The train noise level was combined with the estimated peak hour traffic noise level on Route 9, to obtain cumulative (traffic plus

train) noise level and to determine the distance to 66 dBA noise contour adjacent to these alternatives.

Task 3: For build alternatives B, C, E and F, estimated distance to 66 dBA noise contour was compared with distance to 66 dBA noise contour for Alternative A in order to identify increases in distances to the 66 dBA noise contour for the build alternatives. For each of the build alternatives, potentially affected sensitive land uses were identified within 66dBA noise contour for assessing noise impacts.

Task 4: Total area, in acres, of potentially affected sensitive land uses was calculated along the alignment where noise impacts were determined as described in Task 3.

Task 5: Considered potential mitigation using feasible and reasonable noise barriers.

3.0 Basic Concepts of Noise

A number of factors affect sound, as the human ear perceives it. These include the actual level of sound (or noise), the frequencies (or pitches) involved, the period of exposure to the noise and the changes or fluctuations in noise levels during exposure. Noise levels are measured in units called decibels. Since the human ear is not equally sensitive to all frequencies, measured sound levels (in decibel units at standard frequency bands) are often adjusted or weighted to correspond to the frequency response of human hearing and the human perception of loudness. The weighted sound level is expressed in units called A-weighted decibels (dBA) and is measured with a calibrated noise meter.

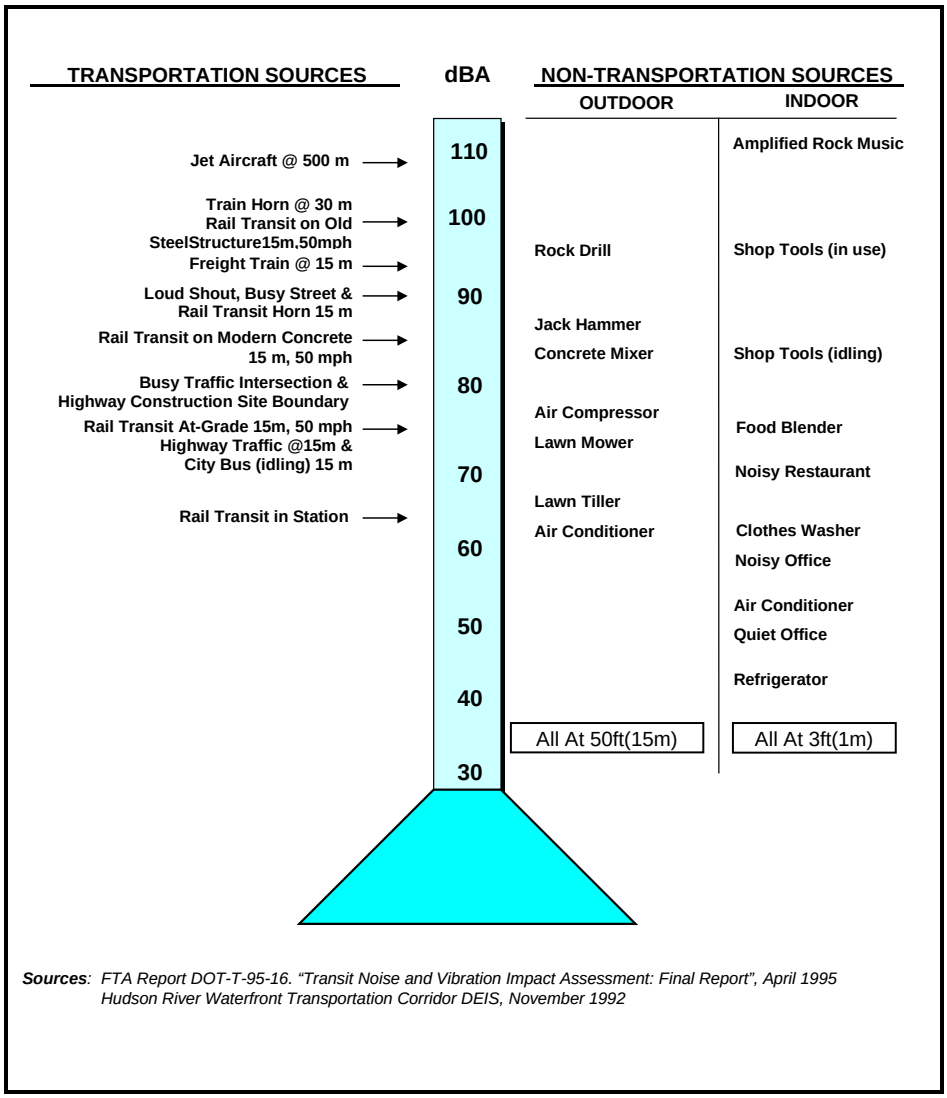
The ability of a typical individual to perceive changes in noise levels is affected by the existing noise levels. A 10 dBA change in noise levels is normally perceived as a doubling or halving of noise intensity or energy and a 5 dBA difference is commonly perceived as a readily noticeable change in noise levels.

The general principle on which most noise acceptability criteria are based is that a change in noise is likely to cause annoyance when it intrudes on existing noise from all other sources. That is, annoyance depends on a consideration of both existing noise levels and the increase in noise levels due to the proposed action. Maximum noise levels (L_{max}) in a community typically range between 45 dBA, the approximate average daytime level in a typical quiet living room, and 80 dBA, the approximate level at about 50 feet from a single pass-by of a fast-moving suburban train. For reference and orientation to the decibel scale, representative environmental noises and their respective dBA levels are shown in Figure 1.

4.0 Potential Impacts

Future peak hour traffic noise levels were estimated along I-29, US 169, North Loop and Route 9. 66 dBA contour Base Condition (Alternative A) was used to determine the potential noise impact from build alternatives B, C, E and F. The results of this assessment indicate that only Alternatives C and F would have potential impacts at certain locations along I-29. (There are no traffic impacts under US 169 and Route 9 and the results of the noise impact analysis along these two roadways are presented in Table 3. Traffic noise impacts along North loop under alternatives C and F are presented in Table 3.) Only alternatives with roadway improvements had any noise impacts.

Figure 1
Common Indoor and Outdoor Noise Levels



Sources: *FTA Report DOT-T-95-16. "Transit Noise and Vibration Impact Assessment: Final Report", April 1995*
Hudson River Waterfront Transportation Corridor DEIS, November 1992

LRT noise levels were estimated from source reference noise levels, which were obtained from the FTA manual and peak hourly LRT passages. LRT noise does not significantly add to road traffic noise under both alternatives E and F since the number of LRT trains is much less than the number of road traffic vehicles and LRT trains are generally quieter as they move on continuously welded tracks. Under both alternatives where portions of the corridor are shared by LRT and road traffic, distance to 66 dBA contour from the corridor is the same as it is under the baseline alternative (i.e. there would be no impact from LRT).

The segments along the I-29 corridor where potential impacts may occur are highlighted in Table 1.

Table 1
Comparison of Alternative Impacts
I-29 Traffic Noise

From	To	Distance to 66-dBA Contour (ft)			Potential Impact Alternative C[1] (Partial Roadway)	Potential Impact Alternative F[1] (Partial Roadway With 1st Stage Fixed Guideway)
		Alternative A (Base Condition)	Alternative C (Partial Roadway)	Alternative F (Partial Roadway with 1st Stage Fixed Guideway)		
(M 291)	112th St.	199	199	199	N	N
112th St.	Tiff Spring Rd.	199	199	199	N	N
Tiff Spring Rd.	Rt 152	271	271	271	N	N
Rt 152	Barry Rd.	315	315	315	N	N
Barry Rd.	72nd St.	315	315	315	N	N
72nd St.	64th St.(Rte45)	315	315	315	N	N
64th St.(Rte45)	56th St.	315	315	315	N	N
56th St.	I-635	315	315	315	N	N
I-635	Waukomis	315	315	315	N	N
Waukomis	US 169	368	368	368	N	N
US 169	Vivion Rd.	271	315	315	**Y**	**Y**
Vivion Rd.	N. Oak Tfwy.	271	315	315	**Y**	**Y**
N. Oak Tfwy.	Davidson Rd.	315	315	315	N	N
Davidson Rd.	I-35	315	368	368	**Y**	**Y**
I-35	Parvin Rd.	232	315	315	**Y**	**Y**
Parvin Rd.	Armour Rd.	232	315	315	**Y**	**Y**
Armour Rd.	16th Ave.	199	271	271	**Y**	**Y**
16th Ave.	Bedford Ave.	199	271	271	**Y**	**Y**
Bedford Ave.	River Front St.	232	271	271	**Y**	**Y**
River Front St.	Independence	232	315	315	**Y**	**Y**
Independence	DT Loop	199	271	271	**Y**	**Y**

1. Potential impact was identified if estimated distance to the 66 dBA contour was greater than estimated distance to 66 dBA contour for Alternative A

Table 2 highlights the segments on I-29 where sensitive land uses are present. The table also quantifies the potential area of affected sensitive land use within the 66 dBA contour at the identified segments - the larger this area the greater is the project impact for that alternative. Alternatives C and F are both estimated to have the largest impact on sensitive land uses, affecting approximately 194 acres -- an increase of approximately 47 acres compared to the Alternative A, Base Condition. Table 3 gives the overall summary of noise impacts under each alternative.

Table 2
Affected Acres of Sensitive Land Use along I-29

From	To	Sensitive Area*	Affected Acres		
			Alternative A	Alternative C	Alternative F
US 169	Vivion Rd.	N	--	--	--
Vivion Rd.	N. Oak Tfwy.	Y	45.0	55.0	55.0
Davidson Rd.	I-35	Y	6.0	8.0	8.0
I-35	Parvin Rd.	Y	23.5	27.0	27.0
Parvin Rd.	Armour Rd.	Y	60.0	72.5	72.5
Armour Rd.	16th Ave.	N	--	--	--
16th Ave.	Bedford Ave.	N	--	--	--
Bedford Ave.	River Front St.	N	--	--	--
River Front St.	Independence	Y	13.2	31.8	31.8
Independence	DT Loop	N	--	--	--
TOTAL			**147.7**	**194.3**	**194.3**

* Sensitive areas are residences. If sensitive areas are identified, affected acres were calculated for the segment.

Table 3
Summary of Noise Impacts

Alternative	Description	Traffic Noise Impacts				LRT Noise Impacts
		I-29	US 169	Route 9	North Loop	
A	Base Condition	NA	NA	NA	NA	NA
B	Low Cost	NI	NI	NA	NI	NA
C	Partial Roadway	I	NI	NA	I	NA
E	Low Cost with 1st Stage Fixed Guideway	NI	NI	NI	NI	NI
F	Partial Roadway with 1st Stage Fixed Guideway	I	NI	NI	I	NI

Note: NA – Not applicable, NI – No Impact, I - Impact

5.0 Potential Mitigation

Mitigation measures were explored for those areas where the noise analysis predicts potential impacts with noise levels higher than 66 dBA. Mitigation of noise impacts normally involves treatments at the three fundamental components of the noise problem: (1) at the noise source, (2) along the source-to-receiver propagation path or (3) at the receiver. For the Northland~Downtown MIS Improvements, a possible mitigation is the construction of noise barriers along identified segments of I-29 near the affected areas. This option could be considered if it is found to be reasonable and feasible. Cost estimates associated with the construction of noise barriers are also presented in Table 4.

Table 4
Proposed Noise Abatement

From	To	Noise Barrier		Noise Barrier Wall Length (ft)			Noise Barrier Wall Area[1] (ft^2)			Estimated Cost[2]
		Feasible	Reasonable	West-Side	East-Side	Total	West-Side	East-Side	Total	
US 169	Vivion Rd.	--	--	--	--	--	--	--	--	**--**
Vivion Rd.	N. Oak Tfwy.	Y	N	--	--	--	--	--	--	**--**
Davidson Rd.	I-35	Y	N	--	--	--	--	--	--	**--**
I-35	Parvin Rd.	Y	N	--	--	--	--	--	--	**--**
Parvin Rd.	Armour Rd.	Y	Y	1500	2000	6800	22500	30000	102000	**$2,040,000**
				1500	1800		22500	27000		
Armour Rd.	16th Ave.	--	--	--	--	--	--	--	--	**--**
16th Ave.	Bedford Ave.	--	--	--	--	--	--	--	--	**--**
Bedford Ave.	River Front St.	--	--	--	--	--	--	--	--	**--**
River Front St.	Independence	Y	Y	1200	800	2000	18000	12000	30000	**$600,000**
Independence	DT Loop	--	--	--	--	--	--	--	--	**--**

Assumptions:

1. Noise Barrier Wall Height = 15 feet
2. Barrier Cost \$20/ft^2

6.0 Noise and Vibration during Construction

Construction noise and vibration effects would primarily be associated with construction of alternatives C and F. For the other alternatives construction activities would have short-term noise impacts on receptors in the immediate vicinity of the construction area especially near interchanges and LRT trackwork. Impacts on community noise during construction include: noise from construction equipment and noise from construction vehicles and delivery vehicles traveling to and from the site. The level of impact of these noise sources depends upon the noise characteristics of the equipment and activities involved, the construction schedule, and the distance from sensitive receptors.

Construction noise is regulated by local ordinances and by EPA noise emission standards for construction noise equipment. Except under special circumstances construction activities would be limited to weekdays. Potential vibration effects caused by the project construction would include minor temporary annoyance to people living in adjacent homes. This could be avoided by including vibration specifications in the construction contracts and by occasional vibration monitoring during the construction period.

New Highway River Bridge Crossing Technical Memorandum

April, 2000

1.0 Introduction

As a natural barrier between the Northland and downtown Kansas City, the Missouri River is a physical barrier to safety, mobility and commerce in the Kansas City metropolitan area. Early in the Northland~Downtown MIS scope identification, the need to improve connectivity north and south of the river was identified.

The Problem Definition for the Northland~Downtown MIS identified several basic transportation-related problems currently experienced and/or projected within the Study Area. Most of the basic problems identified in the Problem Definition could be attributed to cross-river travel and the existing bridge conditions.

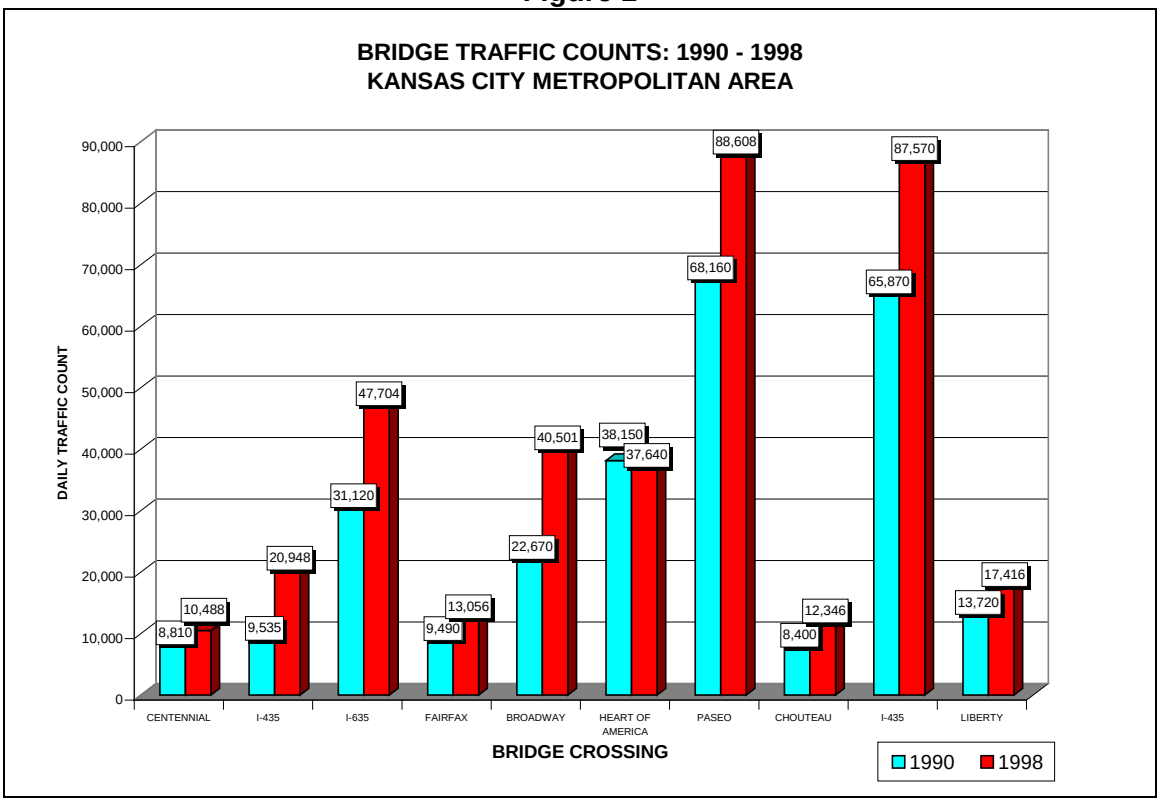
In response to solving the basic problems identified in the Problem Definition and comments from the Steering and Advisory Committees, improvements to river bridge crossings were evaluated. The evaluation looked at improvements to existing bridges as well as new bridge crossings along new alignments. The following technical memorandum summarizes the results of this analysis.

2.0 Existing Conditions

North/south travel in the Kansas City metropolitan area is restricted to bridge crossings across the Kansas and Missouri Rivers. Figure 1 below shows the Missouri River bridge crossings with 1990 and 1998 daily traffic demand. As shown in the figure, daily traffic grew on every bridge crossing except one.

The three study bridges of Broadway, Heart of America and Paseo were grouped together as the primary bridges that serve motorists between the Northland and Downtown. Between 1990 and 1998 the Broadway Bridge grew 79% (9.8%/year) and Paseo grew by 30% (3.8%/year). Both of these bridges represent significant growth. The Broadway and Paseo currently experience daily congestion and poor levels of service during peak periods.

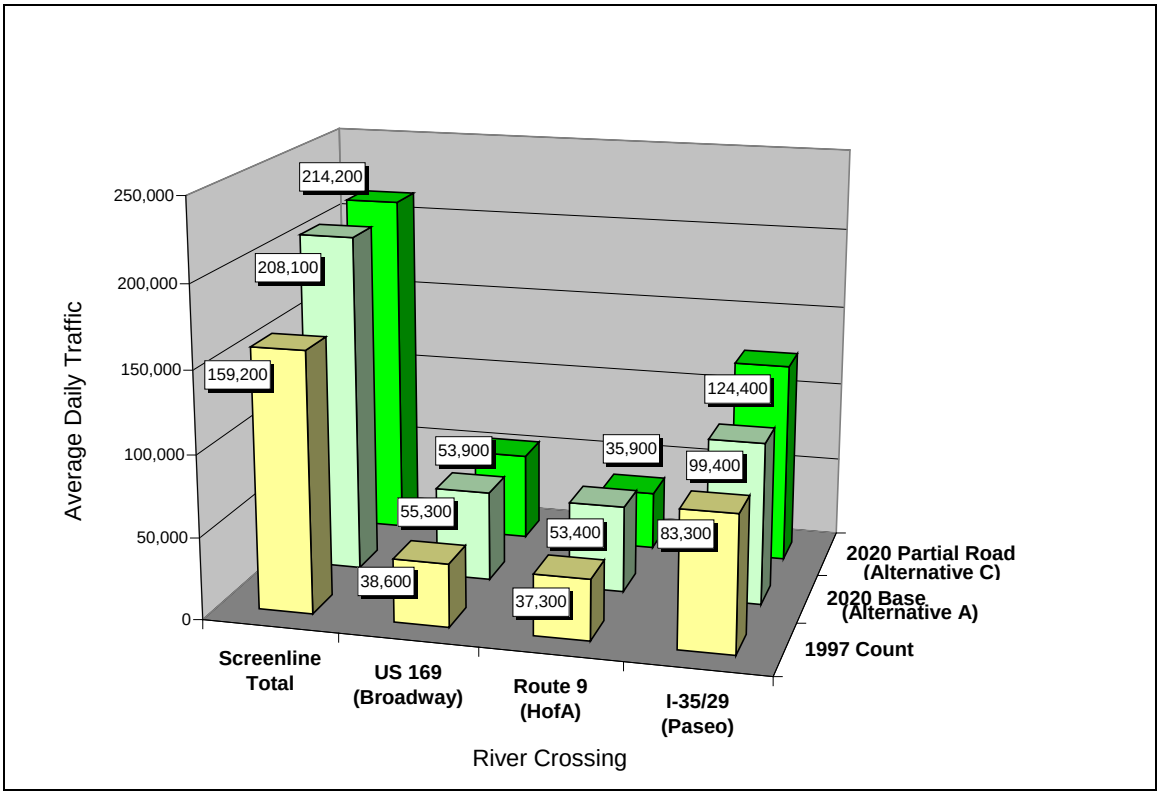
Figure 1



3.0 Alternative C (Partial Roadway)

Using the MARC regional travel demand model, 2020 forecasted traffic demand was identified. Focusing on the three downtown river bridges, traffic demand is expected to increase by 29% through 2020. Figure 2 shows the 2020 forecasted traffic demand for Alternative A (Base Condition) and Alternative C (Partial Roadway) as they are defined in the Initial Strategies Evaluation Technical Memorandum. The Partial Roadway alternative represents the Preferred Strategy for the roadway improvements.

Figure 2
Travel Demand Forecast
Missouri River Screenline



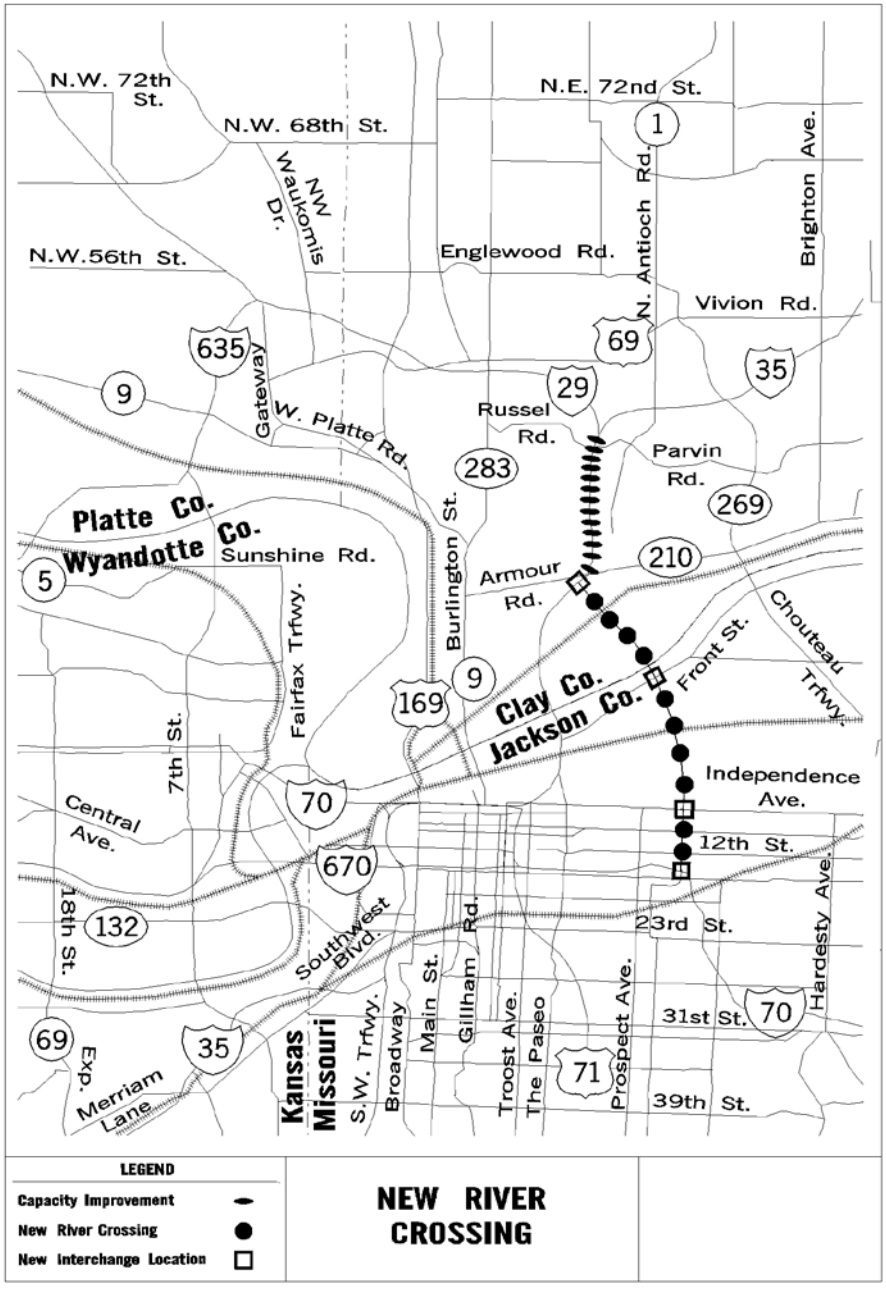
As shown in Figure 2, traffic from the Broadway and Heart of America Bridges are expected to shift to the Paseo Bridge crossing. The Paseo Bridge is expected to increase traffic demand by 25%, whereas, capacity will be increased by 100%. The capacity improvement will provide a much-improved level of service in the future. An alternative to improving the Paseo Bridge is an alternative bridge in a new location. An alternative bridge location would divert traffic not destined for downtown away from the already congested downtown freeway loop.

4.0 New River Crossing Downstream of Paseo Bridge

Numerous new bridge crossing locations were studied in the Northland~Downtown MIS process. Often, physical constraints or the lack of ability to change existing travel patterns were the most common reasons why a new location was not carried forward.

In order to evaluate the benefits of a new river bridge crossing, a new alignment was selected between the Paseo and Choteau Bridges. The location, selected by the Steering and Advisory Committees, begins at the southern termini at the Benton Curve on I-70, north across the river to connect at a northern termini at I-29/I-35 near Armour Road. In order for the river crossing alternative to have a benefit, roadway capacity improvements from the northern terminus north to the I-29 and I-35 freeway split was included. The new river crossing is shown in Figure 3.

Figure 3
New River Crossing



In order to assess the impacts of a new river crossing, Mid-America Regional Council's (MARC) travel demand model was used. Changes in 2020 daily traffic demand and travel characteristics of vehicle miles of travel (VMT) and vehicle hours of travel (VHT) were analyzed.

Table 1 shows the change in daily traffic and the percent change. As shown in the table, the new river crossing is not expected to attract the amount of traffic that you would expect a four-lane freeway to carry efficiently. Also, the new river crossing does not provide a reduction in travel demand on the Paseo Bridge crossing where it is needed to improve service levels.

Table 2 shows the change in motorists travel characteristics. The table shows that for all roadways, vehicle miles of travel and vehicle hours of travel would improve with the new river crossing. This is due to the fact that the new connection provides a shorter travel distance with a new facility and a significant amount of new capacity improving travel times for regional travel. For freeway travel, the distance traveled is expected to increase since there is more lanes miles available.

Table 1
Change in 2020 Daily Traffic Demand with New River Bridge

River Crossings	Change in 2020 Daily Traffic	% Change
I-635	-2,545	-6.3%
US 69	-2,220	-10.9%
US 169 (Broadway)	-1,978	-4.1%
Route 9 (Heart of America)	-14,833	-60.6%
I-29/I-35 (Paseo)	13,605	16.5%
New Crossing	**23,116**	**100.0%**
Chouteau	-4,773	-34.0%
I-435	-9,820	-10.6%

Table 2
New River Bridge Traffic Demand
Travel Demand Model
Measures of Effectiveness

	Change in 2020 Daily Traffic	% Change
Freeways & Expressways		
VMT	54,462	0.2%
VHT	-1,022	-0.1%
Principal Arterials		
VMT	-35,415	-0.5%
VHT	-1,109	-0.3%
Minor Arterials		
VMT	-106,759	-1.0%
VHT	-7,001	-1.3%
All Roadways		
VMT	-87,712	-0.2%
VHT	-9,132	-0.6%

VMT = Vehicle Miles Traveled
VHT = Vehicle Hours Traveled

5.0 Conclusions

The new river crossing would provide a benefit to regional travel. Benefits would include a reduction in distance traveled and a reduction in travel time. However, the amount of traffic that would be diverted to the new facility is not considered to be efficient for the construction of a new four-lane bridge. The new crossing would require a significant amount of property acquisition, impacts to neighborhoods and high construction costs evident with a new roadway alignment. The new river crossing does not improve the primary objective of relieving the most congested river bridge crossing, the Paseo Bridge. Therefore, the best location and concept for improving the efficiency of the existing Downtown bridges is to improve the capacity of the Paseo Bridge crossing.

KCI Transit Ridership
Strategy No. 8 /9 - Fixed Guideway Transit

May, 1999

1.0 Introduction

In order to estimate the ridership potential of a fixed-guideway transit station at KCI, a sketch planning analysis was performed based on the number of enplanements and deplanements at KCI and the origins and destinations of trips to and from the airport. The results of this analysis were then compared with other U.S. airports that have fixed guideway transit service.

2.0 Travel Market Analysis

The KCI passengers who are most likely to use direct transit service to and from the airport are those who are coming from or going to locations that are in reasonably close proximity to the transit line. For this analysis, the primary market area is defined as the downtown Kansas City, Missouri area, including the Country Club Plaza, and the close-in areas east and south of downtown, assuming a continuous system through the Urban Core (i.e., the Southtown Corridor).

Some 26,000 daily airport passengers (non-transfers) enplaned or deplaned at KCI in 1997. According to a 1992 Airport Origin/Destination Study, approximately 12.2% of trips to or from KCI originated from or were destined to the downtown Kansas City area, and 7.3% were exchanged between KCI and the close-in east-side/south-side areas.

Multiplying the 26,000 airport passengers by 12.2% and 7.3% yields a maximum KCI transit market of approximately 3,200 passengers a day to and from downtown and 1,900 passengers to and from the south-side and east-side areas.

The 1992 KCI survey found that some 14 percent of airport passengers used some form of shared-ride mode (taxi, hotel courtesy van, KCI shuttle, airport limousine) to get to and from the airport. With fixed guideway transit, one might assume that the transit system could capture 15% to 25% of all trips to downtown and 10% to 20% of trips to the east-side and south-side areas. This yields a KCI ridership projection of 700 to 1,200 passengers per day. Assuming that airport usage will grow by 1% per year to 2020, the 2020 transit ridership to and from KCI could increase to between 900 and 1,500 per day.

3.0 Comparison with Other Airport LRT Systems

There are a number of factors that affect the percentage of airport passengers that use a fixed-guideway transit service:

- The size of the fixed guideway system. A regional system connecting the airport to many destinations could be expected to attract more riders than a single line.

- The distance and travel time between the rail station and the airport gates. If transit riders must walk long distances or transfer to a shuttle bus, they will be less inclined to use the transit system.

- The transit travel time between the airport and the central business district and other major concentrations of residences, offices, and hotels.

- The percentage of regional employment within the central business district.

- The cost and convenience of access by auto and other competing modes of travel.

To check the reasonableness of the KCI ridership estimates, data was obtained on the market shares achieved at other U.S. airports served by rail. Recent experiences of cities most similar to Kansas City suggest that between 2% and 5% of all airport passengers can be captured with fixed-guideway service. The estimated 2020 daily ridership of between 900 and 1,500 passengers falls within the range of transit market shares achieved in other cities.

Initial Strategies Evaluation Technical Memorandum

May, 1999

1.0 Introduction

This technical memorandum documents the evaluation and screening of the initial transportation investment strategies considered for application within the Study Area. This report follows the identification of transportation investment strategies defined in the *Initial Strategies Definition Technical Memorandum*. This memorandum addresses quality-of-life in the Study Area, an evaluation of initial strategies and a screening of the initial strategies to carry forward alternatives to be analyzed in more detail.

Based on the definition of current and projected problems identified in the *Problem Definition Technical Memorandum*, a multi-modal set of initial strategies were identified. The initial set of strategies identified for the Northland~Downtown MIS are shown in Table 1.

Table 1
Initial Strategies

Strategy Number	Strategy Description
No. 1	Base Condition
No. 2	Low Capital Improvements
No. 3	Travel Demand Management (TDM)
No. 4	Highway Capacity Improvements • Option A – Existing Facilities • Option B – New Facilities
No. 5	Alternative Route Highway Capacity Improvements
No. 6	Expanded Bus Service
No. 7	High-Occupancy Vehicle Lanes
No. 8	Fixed Guideway Transit (BRT)
No. 9	Fixed Guideway Transit (LRT)
No. 10	Fixed Guideway Transit (Commuter Rail)

The initial strategies all have unique benefits and costs associated with them. It is unlikely that a single strategy is the best for the entire Northland area. Consequently, combinations of the above strategies could be identified in order to maximize the benefits and costs for the Study Area.

The Northland~Downtown MIS Study Area, where the initial strategy evaluation occurs, is comprised of mostly the northwest portion of the metropolitan area. The Study Area covers portions of Platte, Clay and Jackson Counties in Missouri. The Study Area extends as far north as I-435 / Cookingham Drive, as far south as the northern portions of the Downtown Central Business District (CBD) loop, Missouri Route 1 on the east side and the Kansas City, Missouri city limits on the west side. The geographic boundary of the metropolitan area located north of the Missouri River is commonly known as the Northland. In this report, the Northland is identified by the boundaries of the defined Study Area. One of the primary focus areas of the study are the three Missouri River crossings of the Broadway Bridge, Heart of America Bridge and the Paseo Bridge. These three River crossings are the only link for travelers between the Northland and the Downtown central business district. As shown in Exhibit 1, the Study Area includes many of the existing major transportation facilities which currently serve the travel markets in north Kansas City.

2.0 Quality-of-Life Issues

This section provides a discussion of the known existing socio-economic and environmental characteristics of the Northland~Downtown Study Area. Data was collected from available resources and databases. Cursory field verification of the known sites was also performed. The existing conditions serve as a baseline for evaluating the direct impacts of the potential improvement strategies.

2.1 Socio-Economic / Land Use

The Kansas City metropolitan area is generally recognized as the ten county area, encompassing approximately 5,000 square miles and home to a population of over 1,500,000. Kansas City North is that part of the city limits which lies in the southern portions of Clay and Platte Counties, north of the Missouri River covering 160 square miles with a 1990 population of over 94,000.

The Northland is socially and economically diverse and represents Kansas City's most significant opportunity for growth with over 75 percent of all the vacant land remaining in the city limits. The Northland epitomizes both the opportunities and problems of traditional suburban development which tends to occur in a linear fashion along the interstate highway system and is highly dependent on use of the automobile. This is especially true north of the river where development follows I-35, I-29 and US 169 leaving large areas of available land between the primary roadways.

The unique natural character of the Northland has contributed to the existing growth pattern. The area is characterized by a predominance of north-south streams and ridges separating watersheds. The construction of roadways is simplified by avoiding the steep slopes and stream crossings. To a large extent this condition has resulted in the strong north-south arterial street system north of the river and the lack of east-west connections.

Study Area Characteristics

The Study Area includes property located within ten different municipalities; Kansas City, Gladstone, North Kansas City, Riverside, Parkville, Northmoor, Houston Lake, Lake Waukomis, Platte Woods, and Weatherby Lake. It also includes the primary transportation corridor between Downtown Kansas City and Kansas City International (KCI) Airport. There are seven

primary population centers in the Northland which do not necessarily conform to municipal boundaries and are therefore, in some cases, referred to by a major street or activity center. Two of the seven, the northern North Oak Corridor and the City of Liberty lie outside the study area boundary. The remaining five are located wholly or partially within the Study Area. Exhibit 2 shows the population centers identified below.

- **Gladstone** is located on the eastern edge of the Study Area. It is primarily developed with commercial and residential land uses. Growth in Gladstone is limited to redevelopment due to the scarcity of vacant land. The major activity center in Gladstone is that portion of North Oak Trafficway, which lies within the city limits.

- **The City of North Kansas City** is at the southern end of the corridor and also has limited potential for growth. It is primarily developed in industrial uses with some commercial and residential uses. The most significant development in North Kansas City in recent years is the construction of Harrah's Casino at the eastern-most city limit.

- **The First Annexation area of Kansas City North**, between Gladstone and North Kansas City, represents just fewer than 50 percent of the population of Kansas City north of the Missouri River. It is nearly 85 percent built out with limited potential for infill development.

- **Line Creek Valley**, the primary growth center in the study area corridor, represents approximately 25 percent of the population of Kansas City North and has experienced nearly half of all new housing starts north of the Missouri River.

- **Downtown Kansas City**, immediately south of the Missouri River, is the southern anchor, and home to the most significant entertainment, cultural, government and employment centers within the Study Area.

Socio-Economic and Demographic Characteristics

Population growth for the Study Area is strong. The Study Area population is expected to grow at a rate of over 5 percent, during the ten-year period between 1997 and 2007 to a total population of 246,988 persons. Table 2 shows a sampling of data related to census tracts within the Study Area.

Study Area residents are 82 percent non-minority. The non-minority proportion of the population is expected to increase. The majority of the population is between the ages of 25 and 64 years with the largest proportion between the ages of 30 and 40. Over 85 percent of the persons over 25 years of age have at least a high school education with 16 percent having bachelor's degrees and 6 percent with graduate degrees.

Households in the Study Area are predominantly families, however 34 percent are non-family. The average household size is 2.4 persons. The households in the Study Area are characterized by relatively high incomes with a median household income of $41,428. High-income households are a strong attraction for continued commercial, office and high-end residential development.

Labor related information in the Study Area is summarized in Table 3. Included in this table are census tracts directly adjacent to I-29 and north of the Missouri River. The labor force information is updated to 1997 and projected to 2007, showing a healthy increase in employed persons over the period. At the same time, unemployment rates in the Study Area are expected to remain low, at or below four percent. This is expected to occur predominantly in single occupancy vehicles. As a whole, public transportation only had a one- percent mode split, according to Census data. The majority of residents are within 45 minutes of their place of employment with 49 percent within 30 minutes.

In 1990, managerial and professional occupations made up 28 percent of the residents' occupation in the portion of the Study Area north of the Missouri River and technical, sales and administrative positions made up the largest percentage at 39 percent. This occupational mix compares favorably with the Kansas City metropolitan area as a whole where only 24 percent are employed in managerial and professional occupations.

Existing and Planned Land Use

Existing Land Use

The current mix of land uses in the Study Area includes manufacturing, office, institutional, cultural, airport/airfield operations, parks and open space, residential and agricultural land. Of this mix, the most land-intensive use in the Study Area is KCI Airport at the northern end and the highest density development is in the Central Business District at the southern extreme of the Study Area. Existing land use in the Study Area is shown on Exhibit 3.

The downtown loop is the true center of the metropolitan area and is the anchor at the south end of the Study Area. It includes large office centers, the center of government, important cultural institutions, and the center of convention and tourism activity. In recent years new residential development has been constructed in the Garment District and Quality Hill adding an important component to the variety of uses identified above.

The remainder of the information shown in Table 3 is derived from 1990 Census Data. The majority of workers, 98 percent in the Study Area commute within the Kansas City Metropolitan Statistical Area for employment, approximately 66 percent commute to the Central City, 32 percent to other parts of the metropolitan area and 2 percent working outside the Metropolitan Statistical Area. There are generally two workers per household who travel to work

North of the downtown loop and south of the Missouri River is the Riverfront/River Market Area, which has a variety of urban uses, including business, tourist destinations and residential activity. The district is characterized by high occupancy rates in rehabilitated residential and commercial facilities and continued reinvestment and revitalization of both public and private resources. The new Riverfront Park provides an additional amenity to the area and region as a whole. Just west of the CBD is the West Bottoms or Central Industrial District. This district has many of Kansas City's oldest buildings and is characterized by heavy industrial uses and those businesses, which support heavy industries. This land use pattern continues throughout the Missouri River Basin heading north across the river into North Kansas City.

Typical, suburban development including residential subdivisions, and strip commercial characterize the area moving northward in the I-29 and US 169 corridors. This land use pattern is highly dependent on the use of the automobile and the highway system. Large-scale

regional shopping centers and strip commercial centers serve the needs of the surrounding residential areas. Commercial areas are strung along arterials or concentrated at major highway interchanges. Primary commercial locations in the Study Area include:

- The downtown loop
- Armour Road in North Kansas City,
- North Oak Trafficway in Kansas City and Gladstone,
- Vivion Road in Kansas City North
- The area surrounding the 64th Street and Barry Road Interchanges with I-29
- Antioch Mall
- Metro North Mall - Metro North Mall is located on the eastern edge of the Study Area but is included given its significant impact on the region.

In almost every case commercial areas strain the capacity of arterials serving them. In addition, movement from activity center to activity center is limited by incomplete arterial and collector roadways.

The residential subdivisions typically feature a lower density of development, often oriented around curvilinear or cul-de-sac streets. Residential development is characteristically segregated by housing type and cost, however there is a good diversity of housing types. Affordable housing is primarily served through existing, older housing stock with new housing catering to higher incomes. Recent building permit activity (in the last 10 years), shows higher demand for multi-family residential in the corridor than in the previous 10 years.

In addition to the older industrial areas and the downtown loop at the south end of the Study Area, the KCI Airport at the north end represents the major center of office/warehouse activity north of the river. The office market along I-29 near the Airport has seen tremendous growth over the last 10 years. In addition, the Airport is a major employer in the Study Area and the region with approximately 7,000 persons employed directly, and another 3,100 in related employment.

A high percentage of agricultural property and undeveloped land remains within the Study Area. This is especially true of the area north of Route 152 and surrounding KCI. Development pressure is strong and consistent but remains centered on existing roadway corridors as developers avoid costly arterial and collector roadway construction to the extent possible.

Existing activity centers, that are primary destinations for trips in the Northland, are shown in Table 4 and identified on Exhibit 4.

Table 2
Population and Household Census Data

Population Characteristics	Number	Percent
Persons (percents are percent change from 5 years previous)		
1997	222,933	
2002	234,826	5.30%
2007	246,988	5.20%
Sex (1997 base year - percents are percents of total)		
Male	108,105	48%
Female	114,828	52%
Race (1997 base year - percents are percents of total)		
White	181,781	82%
Black	31,520	14%
Other Races	9,632	4%
Hispanic Origin (of any race)	12,174	6%
Age (1997 base year - percents are percents of total)		
Persons 65 and Older	25,566	12%
Persons 25 to 64 years	121,287	54%
Persons 14 to 24 years	30,043	14%
Education (persons 25 yrs+ 1997 base year - percents are percents of total)		
Less than 9th Grade	7,906	5%
Some High School - no degree	13,193	9%
High School Graduate	52,193	36%
Some College - no degree	30,128	21%
Associates Degree	9,493	7%
Bachelor's Degree	24,936	16%
Graduate Degree	9,004	6%
Household Characteristics		
Households (1997 data)	88,587	100%
Family Households	58,343	66%
Non Family Households	30,153	34%
Average Household Size (1997 data)	2.4 persons	
Average Family Size	3.0 persons	
Household Income (1997 data)		
Less than $10,000	7,973	9%
$10,000 to $24,999	16,832	19%
$25,000 to $49,999	23,033	26%
$50,000 to $74,999	17,717	20%
$75,000 to $99,999	8,858	10%
$100,000 to $149,999	12,402	14%
$150,000 or more	1,772	2%
Median Household Income	$41,428	

Table 3
Economic Census Data

Labor Force (1997 data)	**Number**	**Percent**
Employed (percent is percent of change in 5 years)		
1997	71,586	
2002	79,593	11.20%
2007	86,640	8.90%
Unemployed (percent is percent of total)		
1997	2,859	4%
2002	3,208	4%
2007	3,522	4%
Place of Work (1990 Census Data)		
Worked in MSA of residence		
Central City	40,810	66%
Other part of same MSA	19,754	32%
Work outside MSA of residence	1,527	2%
Workers in Family (1990 Census Data)		
No Workers	2,675	
One Worker	7,620	
Two Workers	17,216	
Three or more Workers	4,303	
Means of Transportation to Work (1990 Census Data)		
Car, Truck, or Van		
Drove Alone	51,135	82%
Car Pooled	7,329	12%
Public Transportation		
Bus	689	1%
Taxicab	50	
Motorcycle	73	
Bicycle	100	
Walk	640	1%
Other	431	
Work at Home	1,630	3%
Travel Time to Work (1990 Census Data)		
Less than 5 minutes	1,289	2%
5 to 14 minutes	15,442	26%
15 to 29 minutes	29,874	49%
30 to 44 minutes	10,179	17%
45 to 59 minutes	2,256	4%
Over 60 minutes	1,370	2%
Occupation (1990 Census Data)		
Managerial and professional specialty occupations	17,676	28%
Technical, sales, and administrative support occupations	24,365	38%
Service Occupations	6,716	11%
Farming, forestry, and fishing occupations	484	1%
Precision production, craft, and reapir occupations	6,278	10%
Operators, fabricators, and laborers	7,508	12%

Table 4
Activity Centers

Employment Centers	Retail Centers	Entertainment/Cultural Centers
Downtown Loop	Downtown North Kansas City	Downtown Loop
River Market	North Oak Trafficway	Barrybrook/Barry Crossing
West Bottoms	Antioch Mall Area	
North KC Industrial Area	Treemont/Picture Hills	
Downtown Airport	Barrybrook/Barry Crossing	
KCI Airport	Metro North Mall	
Airworld/Executive Hills		

- **Vehicular Connectivity** - Generally there is adequate vehicular access to activity centers along I-29 and US 169, however, there is considerable congestion at the highway interchanges due to amount of traffic generated at these centers and the capacity of the systems in place. Connections between activity centers are less adequate with all traffic using a limited number of arterials and collectors. Finally, the greatest challenge to vehicular connectivity is access across the Missouri River.

- **Public Transit Connectivity** - There is limited public transit available in the Study Area. Service is limited to major routes and feeder bus service is unavailable to easily connect customers from their homes to pick-up points. Public transit is geared to carrying passengers to employment locations south of the river and buses suffer the same delays as other vehicles in crossing the river. There is little public transit connectivity among activity centers in the Northland.

- **Bicycle and Pedestrian Connectivity** - Northlanders have very few options for substituting vehicular trips with bicycle or pedestrian trips. Access for these modes across the north/south major routes is very dangerous and neither pedestrians nor bicycles are accommodated on the highway system. In addition pedestrian connections among activity centers and from neighborhoods to activity centers are rare north of the river and unavailable crossing the river.

Planned Land Use

The recently adopted Comprehensive Plan for Kansas City, Missouri, FOCUS (Forging Our Comprehensive Urban Strategy) gives clear direction for future development within the Study Area. The Northland represents Kansas City's greatest development opportunity in terms of vacant land. Under the FOCUS Plan, transportation systems are seen as important shapers of urban form and land use.

An important conclusion of the planning effort is the establishment of Priority Development Zones. The zones impacting the Study Area are shown on Exhibit 5. These zones have relatively shared development characteristics, are served by existing infrastructure and meet one of FOCUS's primary objectives in fostering infill and contiguous development rather than continuing the sprawling pattern currently taking place. The priority development areas are defined as follows:

- **Employment Area** - This is an area of significant economic activity and employment and exhibits potential for new development. These areas are seen as primary targets for incentives of all types to encourage mixed-use and higher density development taking advantage of existing transportation and utility networks and building the critical mass to support expanded public transit.

- **Older Urbanized Area** - In most cases these are also employment areas and are the oldest, developed portions of the City and Study Area. There is considerable residential land use with associated commercial development in the urbanized area north of the river. There are sites available for development and redevelopment, which will take efficient advantage of existing infrastructure.

- **Urbanizing Area** - This portion of the Northland is the major growth area. Higher densities are encouraged through the FOCUS Plan around existing activity centers. There are a number of existing centers with sub-areas that are still developing or are candidates for infill development.

- **Undeveloped Area** - This area is seen as the lowest priority for encouraging new development. There is a large proportion of unplatted land with much of it in agricultural use.

Through the FOCUS planning process it was determined that development should be encouraged within the Development Priority Zones. This means that public infrastructure construction and investment will go to these areas first as well as fiscal and/or regulatory incentives. In essence, the public sector will do everything possible to guide development to areas with existing infrastructure, those which are contiguous to existing development and those which contribute to a more compact land use pattern.

Development Trends

The Study Area continues to experience strong development interest with no indication of slowing in the foreseeable future. There is, however, development occurring to the east in the Shoal Creek Valley, which may have some impact on the pace of new project construction in the I-29 corridor. The completion of the Shoal Creek Parkway will open up a considerable amount of land to the east and perhaps pull some of the commercial interest to that area over the next five years.

This stated, projections indicate that the population of the Study Area will continue to grow. The economic development potential of the corridor is significant, providing jobs to those within the Study Area as well as the region. Current growth trends are resulting in a land consumption pattern of single-use, residential and commercial development typical of suburban areas. As an alternative, the Kansas City Northland FOCUS Plan recommends targeting development to Priority Development Areas as shown on the FOCUS Development Priorities Map. Essentially the entire Study Area is considered prime for development with infill targeted to the Older Urbanized Area, continued development of the Urbanizing Area and concentrated support of continued growth in the employment area surrounding KCI. These Northland recommendations are supported by the FOCUS Urban Core Plan, which recommends strategic investment in the downtown loop, River Market and West Bottoms areas to increase their potential as viable urban activity centers.

As a result, the overall land use pattern of the Study Area is not expected to change significantly, however, the form of development will take on a more concentrated, mixed-use character. Implementation of the FOCUS recommendations center on future development being structured around a hierarchy of defined centers. Generally speaking, these are not new locations but the same activity centers identified previously with emphasis on creating a more compact development pattern, creating commercial nodes rather than strip development, and providing a true mixing of uses bringing home, work and shopping closer together. Consistent with the FOCUS Plan recommendations, the following activity centers have been identified.

- **Regional Mixed-Use Centers** - **Downtown and Metro North** These Centers will be characterized by concentrations of commercial development and other land uses serving the entire region. These centers are planned to include major land use attractions such as hotels, regional shopping, residential densities greater than 20 dwelling units an acre, cultural facilities, major office developments, hospitals, and educational institutions. These centers are intended to be primary destinations and linkages for all modes of transportation.

- **Community Mixed-Use Centers - Metro North, Antioch, Tremont/Picture Hills, Barrybrook/Barry Crossing, Parkville, Downtown North Kansas City, Line Creek (the single new proposed center)** These are subregional nodes of commercial and other community serving activities. They will be less intense than regional centers including community and regional shopping, densities greater than 14 dwelling units an acre, cultural facilities, medical and professional offices, and financial institutions. These are also intended to serve as major destinations linking all modes of transportation in the corridor and the region.

- **Park and Ride Center - Metro North, Executive Hills, and North Kansas City** This type of center is located in outlying suburban areas along dedicated transit corridors and major express bus routes. The intent is for suburban residents to drive to park-n-ride facilities to connect to express service to the other centers described above.

It is important that transportation retain and improve access to and mobility through these centers as development continues.

Neighborhood Connectivity

Connections between neighborhoods is a serious concern in the Northland. It is lacking in old and new neighborhoods alike. With few exceptions, neighborhoods in the Study Area are residential subdivisions that are inwardly focused and lack physical linkages to centers of community activity such as schools, parks and shopping and to each other. Lack of connecting streets isolates neighborhoods, creates long travel distances, and forces automobile traffic onto the arterial streets thereby adding to congestion. The cul-de-sac layout common of both existing and proposed residential development in the Study Area discourages walking and requires more auto oriented trips.

In addition, existing highway and arterial systems form insurmountable barriers between neighborhoods consistently throughout the corridor. The emphasis of the current system is clearly on the efficient flow of vehicular traffic rather than on the encouragement of alternative modes of travel.

2.2 Air Quality

The Environmental Protection Agency has designated the Kansas City metropolitan area as a maintenance area for ozone and carbon monoxide, and as an attainment area for other transportation-related pollutants. This means that the region's air quality currently meets the National Ambient Air Quality Standards for protecting human health and welfare. For carbon monoxide and ozone, the state is required to have a plan for ensuring that the region's attainment status is maintained.

2.3 Noise Quality

The noise generated by transportation facilities can affect the quality-of-life for communities and residents. At extreme levels, noise can interfere with normal everyday activities such as sleeping, reading, and conversation. Highway noise can be annoying for those living close to a heavily traveled roadway, especially where there is a significant number of trucks. The noise from buses can also be annoying. Light rail vehicles tend to operate quietly, but can create noise at grade crossings if bells and horns or whistles are used. The Federal Highway Administration and the Federal Transit Administration have established guidelines that identify the noise levels that are permissible for various categories of land use.

Transportation facilities can also cause ground-borne vibrations. These vibrations may be felt by people nearby, cause structural damage, or interfere with sensitive manufacturing or scientific processes.

2.4 Energy

Energy is a non-renewable resource that should be conserved in the transportation sector. To reduce energy consumption, petroleum use, congestion, carbon emissions, and other environmental impacts, relationships like overall demand, fuel efficiency, mode choice and loading, fuel choice, and traffic flow could be considered. Awareness of the need to plan for energy conservation was at its peak in 1973 with the oil embargo. Since then, support for conducting energy conservation studies and exploring other alternatives aimed at promoting greater transportation efficiency have been analyzed. In addition to conservation benefits, reductions in energy usage also have environmental benefits. Policies relating to energy conservation standards and requirements, pricing, incentives, and future land use and infrastructure development could be established.

Nationally there are a number of measures that could be taken to conserve energy. There are a number of steps that could be taken at the local level to improve energy conservation as well. Several specific measures that perhaps could be taken within the Northland~Downtown Study Area are to improve land use patterns, shift to more efficient modes of transportation, increase load factors, reduce demand and congestion, and increase energy conservation efficiency. Land use planning may help reduce energy consumption by minimizing trip distances. Favoring development that locates households and businesses in smaller, denser, more compact metropolitan areas, and encouraging a mixed-use development pattern could reduce energy consumption because the distance between trip origins and trip destinations has been reduced. Coordinated with a community's land use planning, transportation measures might be taken to further reduce energy consumption. Encouragement of ridesharing, non-motorized transportation (adding bicycle lanes), public transit modes, and the possible development of a metropolitan-wide light rail system would all be possible efficient ways to reduce congestion,

enhance mobility, and save energy. Table 5 shows the energy expended for various modes of travel. By supporting modes of travel that have higher occupancy rates, thus having lower energy usage per passenger mile, energy consumption can be reduced.

Table 5
Energy Conservation

Transportation Mode	BTU/ Veh-Mile	Average Occupancy	BTU/ Pass. Mile
Auto	7,360	1	7,360
Car Pool	7,360	4	1,840
Bus	50,000	45	1,111
LRT	56,500	55	1,027
Commuter Rail	72,600	80	908

Source: Lowe D., Marcia, "Alternatives to the Automobile: Transport for Livable Cities," Worldwatch Paper 98, October 1990. Presented in English Units of Measure.

2.5 Natural Resources

An investigation of natural resources located in the Study Area was conducted. Natural resources identified include wetlands, floodplains and threatened/endangered species.

Wetlands were located using United States Geological Survey (USGS) Quadrangle Mapping and Natural Resources Conservation Service (NRCS) Wetland Inventory Mapping for Jackson, Clay and Platte Counties. Identified wetlands within the Study Area are located between the Missouri River and levee on the north side of the river, around the west side of the Downtown Airport, and within Water Well Park.

Floodplains were located using all available Flood Insurance Rate Maps (FIRM) from the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP) for all cities located within the Study Area. Cities included Kansas City, North Kansas City, Avondale, Gladstone, Houston Lake, Lake Waukomis and Platte Woods. Identified floodplains within the Study Area are located at the wetlands, west of North Broadway (US 169) to Route 9, Lake Waukomis, Rock Creek, Line Creek, Second Creek, Wildcat Branch, Todd Creek and tributary channels. The majority of the floodplains exist in parts of North Kansas City and the Line Creek basin.

Threatened/endangered species issues were identified by contacting the U.S. Fish and Wildlife Service, Ecological Services office in Columbia, Missouri. Identified threatened/endangered species include the Pallid Sturgeon, and candidate species Sicklefin Chub and Sturgeon Chub, located in the Missouri River, tributary mouths and along main channel borders. Also identified is the Indiana Bat, located within wooded riparian forests, floodplain forests or upland woodlots containing dead or dying trees with exfoliating bark such as within the Line Creek basin.

2.6 Hazardous Waste Sites

Previously recorded hazardous waste sites were identified through use of an environmental database firm called EDR Environmental Data Resources, Inc. Due to the irregular shape of the Study Area, radius or corridor offset maps could not be used. Instead, information was obtained by zip code. Identified hazardous waste sites within the study area are located

primarily within North Kansas City and in the Downtown Kansas City area. Concentrations exist along Grand Boulevard, Burlington (Route 9), Swift , Armour (Route 210), 10th Avenue, 14th Avenue and KCI Airport.

2.7 Cultural Resources

Cultural resource sites were identified from the Kansas City, Missouri Register of Historic Places, National Register of Historic Places, Missouri SHPO, U.S. Army Corps. Of Engineers, Kansas City Landmarks Commission and additional information from Jackson, Clay and Platte County Historic Societies. Sites identified within the Study Area include individual structures, historic districts, and archeological sites primarily located within Downtown Kansas City (within the downtown loop and the industrial area south of the Missouri River).

2.8 Parklands

Potential Section 4(f) and Section 6(f) properties were identified through the Kansas City, Missouri Board of Parks and Recreation, Missouri Department of Natural Resources Division of State Parks, Jackson, Clay and Platte Counties, and cities located within the Study Area.

No state parks or federal wildlife refuges exist within the Study Area. Proposed parks identified within the Study Area are located just north and south of the Missouri River, west of the Downtown Airport levee, adjacent to Water Well Park, adjacent to Water Works Park, adjacent to Northgate Park, within the Line Creek basin, proposed intersection of Tiffany Springs and Line Creek Parkways, along the west extension of Tiffany Springs Parkway, and along NW Cookingham (Route 291) at I-29.

Existing parks identified within the Study Area include West Terrace, Kemp, Belvidere, Kessler, Maple, Columbus Square, Garrison Square, Riverfront, Mackern, Water Well, Water Works, Briarcliff Greenway, Riverview Greenway, Riverview, North Hills, Sunset, Rock Creek, Chaumere Woods, Prather, Crestview, Northgate, Golden Oaks, Davidson, Englewood, Morgan Tract, Strathbury, Green Hills, Woodsmoke, North Congress Greenway, Forest, Barry Road, Widberry, Line Creek, Robinhood, Barry Platte, and the median to the KCI Airport entrance.

Existing parkways/boulevards identified within the Study Area include Broadway, Grand, Admiral, Paseo, Maple, Lexington, Independence, Riverfront, Briarcliff, and Tiffany Springs.

Proposed parkways include portions of Broadway and North Broadway (US 169), Front Street, west levee around Downtown Airport, west extension of Briarcliff Parkway to I-29, Line Creek Parkway, NW 56th Street west of Line Creek, Barry Road west of Line Creek, and the east and west extensions of Tiffany Springs Parkway.

3.0 Evaluation of Initial Strategies

An evaluation of the improvement strategies identified in the *Initial Strategies Definition Technical Memorandum* was performed to screen those strategies warranting further consideration and more detailed study. This screening is refereed to as Phase I analysis. The screening of strategies involved developing the definitions for the evaluation factors (measures of effectiveness) and applying those definitions and methods to the improvement strategies. Phase II of the Major Investment Study will provide a more detailed analysis of the screened alternatives.

The evaluation of initial strategies is laid out in the following sections.

- Evaluation Methodology
- Transportation and Mobility
- Environmental Impacts
- Community and Development
- Financial Impacts
- Overall Strategy Evaluation Summary

3.1 Evaluation Methodology

Evaluation factors were developed from the study goals and objectives of the study. The evaluation factors coincide with the goals for long-range planning efforts for the Northland, the region and the major investment study goals outlined in the Intermodal Surface Transportation Efficiency Act (ISTEA) and the Transportation Efficiency Act for the 21st Century (TEA21). These goals are outlined below and described in Appendix A.

MIS Goals	**LRTP Goals**
• Effectiveness	• System Preservation
• Cost Effectiveness	• Personal Mobility & Quality-of-Life
• Financial Feasibility	• Land Use and Development
• Equity	• Regional Economy
	• Safety
	• System Management & Efficiency
	• Funding

Once the evaluation factors were established, an overall matrix was developed to evaluate each of the strategies. The evaluation matrix for all of the strategies analyzed is located in Section 3.6 in this Technical Memorandum (Table 24).

3.2 Transportation and Mobility Impacts

Traffic congestion imposes delays on motorists and frequently leads to increased accidents. Decreased travel efficiency and safety leads to increased costs for motorists and the public. There are a number of locations in the Northland where traffic congestion problems exist. The Missouri River crossing is the most critical of the identified problem areas.

The primary goal of any improvement strategy is to reduce or eliminate the current transportation deficiencies in the Northland. The primary operational benefits to travelers include travel time savings and fewer accidents. The following section identifies the transportation and mobility impacts associated with the improvement strategies and their ability to achieve the transportation goals of the Northland.

Traffic Volumes

Changes in Northland traffic volumes occur when improvement strategies are implemented. Changes in traffic volumes are compared to the Strategy No. 1, Base Condition to determine the potential benefits of a particular improvement. One of the most critical issues in the Northland Study Area are the three Missouri River crossings. Providing the greatest feasible

river crossing capacity reduces congestion and improves travel efficiency for Northland motorists.

Changes in travel demand or traffic volumes were developed using the region's travel demand model. In Phase I, raw volumes from the calibrated model were used. Only improvement strategies that have a direct impact on automobile travel were modeled in Phase I. Therefore, only strategies with roadway improvements including Strategy No. 4, Highway Capacity Improvements and Strategy No. 5, Alternative Route Highway Capacity Improvements are discussed as they relate to changes in traffic demand and thus improvements to travel in the Northland.

Strategy No. 4 (Highway Capacity Improvements)

Strategy No. 4, Highway Capacity Improvements identifies improvements to the roadway system by improving existing facilities and by adding new facilities to improve roadway conditions.

Existing Facilities

Improvements to existing facilities provides a package of highway capacity improvements within the Study Area such as roadway widening and major interchange improvements. Initial screening of improvements included improvements to existing facilities at four locations identified in the *Initial Strategies Definition Technical Memorandum*.

The package of improvements provides a measurable benefit to Study Area motorists as shown in Table 6. Improvements to existing facilities would attract 15,000 more vehicles per day in both directions across the Missouri River in 2020 than the base condition. This is a 9 percent increase in future traffic demand across the River. The Paseo Bridge carries the majority of the traffic across the Missouri River and would receive the greatest benefit from the strategy improvements.

Changes in system-wide measures of effectiveness would occur as a result of the improvements. Vehicle miles traveled and vehicle hours traveled are indicators of changes in travel behavior that can be expected. The proposed improvements are expected to attract more vehicle miles traveled to the highways. As a result, a decrease in arterial travel would occur and highway travel becomes more attractive to motorists. This benefit translates to an overall reduction of vehicle miles traveled and hours of travel in the Northland.

Table 6 provides a summary of cross river benefits of the entire package of Strategy No. 4A. Below is a description of the impacts of the individual projects and the merits of carrying each forward for further more detailed analysis.

Table 6
Change in 2020 Traffic Demand With Strategy No. 4
Highway Capacity Improvements, Option A – Existing Facilities

Missouri River Crossing	Base Condition	Strategy 4A	Percent Change
I-29/I-35 (Paseo Bridge)	95,968	119,052	24%
Route 9 (Heart of America Bridge) Combined with US 169 (Broadway Bridge)	72,710	64,716	-11%
Total	**168,678**	**183,768**	**9%**

- Improvements to the I-29 Corridor and the Paseo Bridge.

  The roadway improvement provides a benefit to travel conditions in the Northland and travel across the Missouri River by adding additional roadway capacity crossing the Missouri River on the east side of the downtown loop. Since the primary travel from the Northland to downtown must cross the Missouri River, providing needed capacity at this location improves cross river capacity.

  The four lane section from the downtown loop, across the Missouri River to Route 210 is the critical link for motorists travel on I-29/I-35. Increasing roadway capacity in this section provides improved crossing of the Missouri River along the most heavily used bridge crossing. This improvement shows merit to motorist travel.

- Improvements to the US 169 Corridor and the Broadway Bridge.

  The roadway improvement of a single reversible lane addition on US 169 would provide a benefit to travel congestion on US 169. Heavy peak direction travel demand occurs on US 169 between the Northland and areas south of the Missouri River. In the morning peak hour, 75 percent southbound directional distribution and in the evening peak hour 61 percent directional distribution occurs on US 169. This heavy directional distribution would benefit from an additional single reversible lane addition.

- Improvements to the Burlington Avenue (Route 9) Corridor.

  The roadway improvement of adding more capacity to Route 9 does not seem to be a viable solution to existing problems, since Route 9 currently carries less than its current bridge crossing capacity. The primary constraint on Route 9 is the signalization of an urban arterial roadway rather than bridge capacity constraints. MoDOT has coordinated signals along Route 9 in the past and has already provided the most efficient movement of people in the corridor.

- Interchange improvements along US 169 and I-29 within the Study Area

  Interchange improvements identified within the Northland would have a positive benefit on their respective local areas. Improvements in localized travel time, reduced delay and improved safety can be expected as a result of interchange improvements.

  New Facilities

Four new roadways along new alignment are identified under Strategy 4B. Initial screening of improvements includes new roadways, which help relieve traffic demand along existing facilities.

This package of improvements provides only minor benefits to Study Area motorists as shown in Table 7. Improvements to new facilities would attract 4,200 more vehicle per day in both directions across the Missouri River in 2020. This is only a 3 percent increase in future traffic demand across the River. US 169 would provide the greatest improvement in travel demand of the three bridge crossings.

Changes in system-wide measures of effectiveness would occur as a result of the improvements. Vehicle miles traveled and vehicle hours traveled are indicators of changes in travel behavior that can be expected. The proposed improvements are expected to experience a slight decrease in highway vehicle miles traveled. Arterial miles traveled are expected to see a slight increase. As a result of the added freeway capacity, vehicle hours traveled on highways is expected to improve, but arterial travel is expected to slightly worsen. Overall roadway conditions are expected to see a slight improvement as overall roadway vehicle miles traveled and vehicle hours traveled would decline.

Table 7
Change in 2020 Traffic Demand With Strategy No. 4
Highway Capacity Improvements, Option B – New Facilities

Missouri River Crossing	Base Condition	Strategy 4B	Percent Change
I-29/I-35 (Paseo Bridge)	95,968	98,468	3%
Route 9 (Heart of America Bridge) Combined with US 169 (Broadway Bridge)	72,710	74,482	2%
Total	**168,678**	**172,950**	**3%**

Source: Mid-America Regional Council

Table 7 provides a summary of cross river travel benefits of the entire package of Strategy No. 4B. Below is a description of the impacts of the individual projects and the merits of carrying them forward for further analysis.

- East-west limited-access roadway between I-29 and North Oak Trafficway.

  This new link is intended to better utilize the available capacity of Route 9 and help reduce the demand of traffic on I-29/I-35. However, due to numerous traffic signals located on Route 9 between North Oak Trafficway and the downtown loop, slow travel conditions with numerous opportunities for delay reduce the potential for a substantial benefit. The east-west facility would be expected to attract 8,600 daily trips.

- Controlled-access freeway between I-29 and Route 210.

  A new controlled-access freeway at this location is an attempt to bypass the poor operating conditions at the I-29/I-35 interchange with Route 210. However, without improvements to the I-29/I-35 corridor south to the downtown loop, the primary mainline capacity constraint has not been resolved. The proposed freeway would be very expensive to build with numerous rail crossings, thus making the benefit cost ratio undesirable.

- New Missouri River crossing connecting US 169 north of the Downtown Airport to I-35 northwest of downtown, bypassing the Broadway/5th and 6th Street intersections.

  In attempt to relieve congestion from the US 169 Missouri River crossing, this improvement would provide an alternative route into the west side of the downtown loop. Exorbitant costs and physical constraints could not be overcome with the estimated system benefit. The new facility could be expected to attract 17,700 vehicles a day and reduce traffic on the Broadway Bridge by 10,800 vehicles or nearly 30 percent, however, US 169 would still be limited by a constrained four-lane roadway north of the Downtown Airport.

- New north-south limited-access roadway between I-70 and I-29/I-35, bypassing the downtown loop.

  A new north-south facility could be constructed to alleviate motorists from traveling through the downtown loop in order to access destinations in the Northland. As a result, this improvement does have the ability to help reduce travel demand crossing the Missouri River. However, without capacity improvements on I-29/I-35 north of M-210 to the I-29 and I-35 split, the true capacity constraint is not eliminated.

Strategy No. 5 (Alternative Route Highway Capacity Improvements)

Strategy No. 5 Alternative Route Highway Capacity Improvements identifies highway improvements to alternative routes outside the immediate Study Area that could have an impact on Study Area routes and river crossings.

Primary corridors of the Fairfax/7th Street corridor and the Chouteau/Front Street corridor are identified for improvements. The ability for improvements within these corridors to help reduce traffic demand along primary highway routes in the Study Area is the goal.

The package of improvements provides little benefit to Study Area motorists as shown in Table 8. Improvements to alternative routes as a package would decrease 2020 traffic demand by

800 vehicles per day in both directions across the Missouri River. This is less than a 1 percent decrease in future traffic demand across the River.

Changes in system-wide measures of effectiveness would occur as a result of the improvements. Vehicle miles traveled and vehicle hours traveled are indicators of changes in travel behavior that can be expected. The proposed improvements are expected to see a slight decrease in vehicle miles traveled on Study Area highways. As a result, increased travel on Study Area principal arterial routes could be expected. Practically no change in vehicle miles traveled is expected on Study Area roadways as a result of the proposed improvements to alternative routes. A slight decrease in vehicle hours traveled can be expected with small improvements in operating conditions on Study Area highways.

Table 8
Change in 2020 Traffic Demand With Strategy No. 5
Alternative Route Highway Capacity Improvements

Missouri River Crossing	Base Condition	Strategy 5	Percent Change
I-29/I-35 (Paseo Bridge)	95,968	96,270	0%
Route 9 (Heart of America Bridge) Combined with US 169 (Broadway Bridge)	72,710	71,608	-2%
Total	**168,678**	**167,878**	**0%**

Source: Mid-America Regional Council

Table 8 provides a summary of cross river benefits of the entire package of Strategy No. 5. Below is a description of the impacts of the individual projects and the merit of carrying them forward for further analysis.

- Fairfax/7th Street Corridor.

  The Fairfax/7th Street corridor is proposed as an alternative route into downtown from the west side of the Study Area. The Fairfax bridge would need to be improved from two lanes to four lanes along with capacity and signal improvements along 7th Street, State Avenue and Fairfax Trafficway. These improvements are likely to be very expensive and intrusive to neighborhoods and environmentally sensitive areas. The improved facility would be expected to attract 4,700 more vehicles. This would translate to a reduction of only 1,200 trips across the Missouri River for the three downtown river bridges.

  Travel through the Kansas City, Kansas urban core increases travel time and decreases travel speed for motorists to downtown from the Northland.

- Chouteau/Front Street Corridor.

  Chouteau Trafficway and the Chouteau Bridge are currently being improved from two lanes to four lanes. Strategy No. 5 would add 2 more lanes to the trafficway to develop

a six-lane facility. This improvement is intended to provide improved alternative access for downtown-oriented trips, for those trips destined to or originating from areas outside of the urban core. Significant improvements would also need to be undertaken along Front Street in order to fully take advantage of this improvement. This improvement is expected to attract only 400 more vehicles with the improvement from four to six lanes.

These proposed improvements are likely to be very expensive and intrusive to neighborhoods and environmentally sensitive areas. Out of direction travel and slower travel times is not expected to attract a significant number of trips from the I-35/I-29 corridor into downtown.

Roadway Operations

The quality and safety of traffic flow in the Northland is influenced by roadway operations. Motorists travel demand and the physical characteristics of the roadway are the factors that most influence the quality and safety of traffic flow. Level of service (LOS), travel time and safety are three measures influenced most by roadway operations.

Level of Service (LOS)

Level of service is a qualitative measure of vehicle flow. LOS is described with letter designations of A (best) through F (worst). It has been determined from MoDOT standards that LOS D is considered the minimum acceptable freeway LOS in the Study Area. Table 9 identifies which strategies are expected to impact LOS in the Northland.

Table 9
Change in Roadway Miles at LOS D or Better in 2020
Compared to the Base Condition

Alternative Strategy		Change in Percent of Roadway Miles at LOS D or Better
1	Base Condition	Base
2	Low Capital Improvements	No Change
3	Travel Demand Management	No Change
4	Highway Capacity Improvements • Option A – Existing Facilities • Option B – New Facilities	 Improvement Improvement
5	Alternative Route Highway Capacity Improvements	No Change
6	Expanded Bus Service	No Change
7	High-Occupancy Vehicle Lanes	No Change
8	Bus Rapid Transit	No Change
9	Light Rail Transit	No Change
10	Commuter Rail	No Change

As shown in Table 9, most of the improvement strategies would have no measurable effect on overall freeway level of service. Only Strategy 4, Highway Capacity Improvements would provide an improvement in the number of roadway miles with LOS D or better, as compared to the Base Condition. Option A – Existing Facilities would provide an increase of 18 percent

more roadway miles with LOS D or better and Option B – New Facilities would provide an increase of 15 percent more roadway miles with LOS D or better.

Travel Times

Travel times are achieved when vehicles are able to maintain free-flow speeds instead of being delayed by queued vehicles or dense, slow-moving traffic. On freeways, free-flow speeds generally degrade or decrease where travel conditions exceed LOS D. Table 10 shows the expected change in travel time for two routes -- KCI Airport to the downtown loop and the I-29/US 169 interchange split to the downtown loop.

As shown in Table 10, many of the strategies are expected to have no improvement in travel time. Some strategies would be expected to experience an increase in travel time along these two routes. Mostly, the transit strategies would be expected to experience an increase in travel time compared to the Base Condition auto travel. Increased transit travel time is a result of station delay. Decreases in travel time are seen with Strategy 4, Highway Capacity Improvements and Strategy 7, High-Occupancy Vehicle Lanes.

Table 10
Change in 2020 Auto Travel Time
Compared to the Base Condition

Alternative Strategy		KCI to CBD	I-29/US 169 Int. to CBD
1	Base Condition	Base	Base
2	Low Capital Improvements	Increase	Increase
3	Travel Demand Management	No Change	No Change
4	Highway Capacity Improvements • Option A – Existing Facilities • Option B – New Facilities	 Decrease Decrease	 Decrease Decrease
5	Alternative Route Highway Capacity Improvements	No Change	No Change
6	Expanded Bus Service	Increase	Increase
7	High-Occupancy Vehicle Lanes	Decrease	Decrease
8	Bus Rapid Transit	Increase	Increase
9	Light Rail Transit	Increase	Increase
10	Commuter Rail	NA	NA

Accidents

Traffic accidents have a cost to the drivers involved as well as the driving public. The cause of accidents are many and varied, but an accident rate based on several years of experience is generally a reflection of the physical roadway features and the traffic volumes the roadway carries. In gauging whether the accident rate on a particular roadway segment is within reasonable expectations, a comparison can be made of the accident rate on a particular roadway segment to a large representation of similar roadways.

A rating was used to assess traffic data collected and analyzed. The change in the number of 2020 annual accidents was determined for each strategy. Only Strategy 4, Highway Capacity Improvements, Option A – Existing Facilities would have a significant impact on the reduction of

accidents in the Study Area. The majority of the other strategies would have a low to medium impact on the future reduction of accidents in the Study Area.

Transit Service and Patronage

The alternative strategies considered in Phase I offer varying levels of transit service improvements. The Base Condition, represents the bus service that currently exists in the Northland. With the Expanded Bus Service, Strategy No. 6, the transit service area is expanded, and more frequent service is provided. Transit service is enhanced further with the HOV Strategy No. 7, as express buses from the Northland are freed from congestion and motorists travel times improve. The fixed guideway alternatives, both Bus Rapid Transit (BRT) and Light Rail Transit (LRT), give transit an exclusive facility that is separate from congested roadways, allowing higher speeds. Increasing levels of investment provide greater coverage, increased frequencies, higher speeds, and a higher quality of transit service.

Improved transit service can be expected to translate into increased transit ridership. For this screening analysis, a sketch planning technique was used to obtain an order-of-magnitude forecast of ridership under each strategy. This analysis identified those pairs of travel analysis districts that would benefit from improved transit in the Northland. The number of commuters who are projected to travel between those districts was then determined, based on MARC population and employment forecasts for 2020. This forecast was then multiplied by a "capture rate" representing the percentage of commuters that might be expected to use transit for that trip. The results are presented in Table 11.

Table 11
Order of Magnitude Estimate of Transit Ridership Change
Home Based Work Trips (Year 2020)

Alternative Strategy		Change in Daily Transit Ridership
1	Base Condition	Base
2	Low Capital Improvements	0 – 300
3	Travel Demand Management	0 – 300
4	Highway Capacity Improvements	0 – 300
5	Alternative Route Highway Capacity Improvements	0 – 300
6	Expanded Bus Service	800 – 1,200
7	High-Occupancy Vehicle Lanes	700 – 2,700
8	Bus Rapid Transit • KCI to CBD via I-29 Alignment • KCI to CBD via Master Plan Alignment • I-29/Waukomis to CBD	 6,500 – 9,200 6,500 – 9,200 4,600 – 6,800
9	Light Rail Transit • KCI to CBD via I-29 Alignment • KCI to CBD via Master Plan Alignment • I-29/Waukomis to CBD	 6,500 – 9,200 6,500 – 9,200 4,600 – 6,800
10	Commuter Rail	230 – 600

In Phase II, MARC's travel demand forecasting models will be used to forecast transit ridership for each of the screened alternatives.

In order to estimate the ridership potential of a fixed-guideway transit station at KCI, a sketch planning analysis was performed based on the number of enplanements and deplanements at KCI and the origins and destinations of trips to and from KCI. The results were compared with other U.S. airports that have fixed guideway transit service.

The KCI passengers who are most likely to use direct transit service to and from the airport are those who are coming from or going to locations that are in reasonably close proximity to the transit line. For this analysis, the primary market area is defined as the downtown Kansas City, Missouri area, including Country Club Plaza, and the close-in areas east and south of downtown, assuming a continuous system through the urban core (i.e., the Southtown Corridor).

With fixed guideway transit, it was assumed that the transit system could capture 15 percent to 25 percent of all trips to downtown and 10 percent to 20 percent of trips to the east and south side. This yields a KCI ridership projection of 700 to 1,200 passengers per day. Assuming that airport usage will grow by 1 percent per year to 2020, the 2020 transit ridership to and from KCI could increase between 900 and 1,500 passengers per day.

To check the reasonableness of the KCI ridership estimates, data was obtained on the transit market shares achieved at other U.S. airports served by rail. Recent experience of cities most similar to Kansas City suggests that between 2 percent and 5 percent of all airport passengers can be captured with fixed-guideway service. The estimated 2020 daily ridership of between 900 and 1,500 passengers falls within the range of transit market shares achieved in other cities.

3.3 Environmental Impacts

Air Quality

A subjective analysis of air quality emissions was performed as part of the screening of initial strategies. For Phase I, pollutant emissions were assumed to be a function of vehicle miles traveled and congestion. The strategies were rated on a five-level scale of "Low" to "High", with "High" representing the most favorable situation for air quality (i.e., lowest emissions). The results are shown in Table 12.

Table 12
Air Pollutant Emissions

Alternative Strategy		Rating
1	Base Condition	Low/Medium
2	Low Capital Improvements	Low/Medium
3	Travel Demand Management	Low/Medium
4	Highway Capacity Improvements • Existing Facilities • New Facilities	 Medium Medium
5	Alternative Route Highway Capacity Improvements	Low/Medium

6	Expanded Bus Service	Low/Medium
7	High-Occupancy Vehicle Lanes	Low/Medium
8	Bus Rapid Transit • KCI to CBD via I-29 Alignment • KCI to CBD via Master Plan Alignment • I-29/Waukomis to CBD	 Medium Medium Medium
9	Light Rail Transit • KCI to CBD via I-29 Alignment • KCI to CBD via Master Plan Alignment • I-29/Waukomis to CBD	 Medium Medium Medium
10	Commuter Rail	Low/Medium

In Phase I, air quality impacts do not vary significantly across the strategies. The more capital intensive highway strategies can be expected to provide some relief from traffic congestion. With more smoothly flowing traffic, emissions are likely to diminish, but not significantly so at the corridor or regional scale. The more capital intensive transit strategies are also likely to have a positive impact on air quality. By making transit more competitive with the automobile, these strategies are likely to lead to increased transit use, somewhat lower vehicle miles traveled, and reduced pollutant emissions.

Noise Quality

To compare the strategies in terms of noise, a rating was assigned based on a subjective review. The ratings considered, in a general way, the number of sensitive receptors that might be exposed to increased sound levels, and were based on the team's understanding of the areas most likely to be affected. There was no survey to identify sensitive receptors, nor was there any noise monitoring or forecasting. The five-level rating scale ("Low" to "High" was used with "High" representing the most desirable (i.e., quietest) condition. The results are shown in Table 13.

Table 13
Noise Impacts

Alternative Strategy		Rating
1	Base Condition	Medium
2	Low Capital Improvements	Medium
3	Travel Demand Management	Medium
4	Highway Capacity Improvements • Existing Facilities • New Facilities	 Low/Medium Low
5	Alternative Route Highway Capacity Improvements	Low/Medium
6	Expanded Bus Service	Medium
7	High-Occupancy Vehicle Lanes	Medium
8	Bus Rapid Transit • KCI to CBD via I-29 Alignment • KCI to CBD via Master Plan Alignment • I-29/Waukomis to CBD	 Medium Medium Medium

9	Light Rail Transit • KCI to CBD via I-29 Alignment • KCI to CBD via Master Plan Alignment • I-29/Waukomis to CBD	 Medium Medium Medium
10	Commuter Rail	Medium

With the exception of Strategies 4 and 5, very little change in noise levels is expected to occur. With the widening of existing highways these two Strategies could move traffic closer to residences and other noise receptors, plus the increased speeds would lead to higher noise levels. The construction of new highway facilities in Strategy 4 would have the most adverse impact by exposing new areas to highway noise. The transit strategies are not likely to affect noise levels. It is likely that any changes in noise could be mitigated with sound walls and other techniques. Further analysis of noise impacts will occur in Phase II.

Energy Consumption

A qualitative assessment of energy impacts was performed and is reported in Table 14. Again, a five-level rating scale was used ("Low" to "High", with "High" representing the most favorable condition or lowest level of energy use).

Table 14
Change in Energy Consumption

Alternative Strategy		Rating
1	Base Condition	Low
2	Low Capital Improvements	Low
3	Travel Demand Management	Low
4	Highway Capacity Improvements • Existing Facilities • New Facilities	 Low/Medium Low/Medium
5	Alternative Route Highway Capacity Improvements	Low
6	Expanded Bus Service	Low
7	High-Occupancy Vehicle Lanes	Low
8	Bus Rapid Transit • KCI to CBD via I-29 Alignment • KCI to CBD via Master Plan Alignment • I-29/Waukomis to CBD	 Low/Medium Low/Medium Low/Medium
9	Light Rail Transit • KCI to CBD via I-29 Alignment • KCI to CBD via Master Plan Alignment • I-29/Waukomis to CBD	 Low/Medium Low/Medium Low/Medium
10	Commuter Rail	Low

At this level of analysis, the alternatives do not vary significantly in terms of energy consumption. Highway capacity improvements may reduce consumption by allowing vehicles to operate more efficiently. On a passenger mile basis, transit vehicles are more fuel-efficient than automobiles. Thus, transit improvements that lead to higher transit usage and lower automobile usage will help conserve energy.

Natural Resources

Expansion of the Paseo, Heart of America or Broadway Bridges, or any new river crossing, may potentially impact the wetland and floodplain resources located on the north side of the Missouri River between the levee and the river. Construction of a facility along the levee around the west side of the Downtown Airport may also have impacts on the wetland/floodplain between the levee and the Missouri River.

River crossing improvements may also impact an endangered/threatened species identified within the Study Area. The Pallid Sturgeon may have habitats within the Missouri River, tributary mouths and along main channel borders. Candidate species including the Sicklefin Chub and Sturgeon Chub, also located in the Missouri River, may also be impacted.

US 169 lies adjacent to a 500-year floodplain on the Downtown Airport. US 169 and Route 9 both pass through a floodplain area in the vicinity of their interchange near Water Well Park. US 169 passes through another floodplain just south of the I-29 Interchange. Route 9 lies adjacent to a floodplain and a wetland, west of the US 169 Interchange. I-29 passes through a floodplain area just north of Route 210 and two more located between US 169 and I-635. I-35 passes through a floodplain just north of the I-35/I-29 split. The new facility connecting Route 283 with I-29 passes through two floodplain areas.

A fixed guideway alignment along the Line Creek corridor would have impacts on numerous floodplain areas adjacent to Line Creek. This alignment may also impact an endangered/threatened species identified within the Study Area. In the Spring, the Indiana bat may have roost sites located within wooded riparian areas, floodplain forests, or upland wood lots containing dead or dying trees with exfoliating bark. Any tree removal within areas containing these types of trees will need to be surveyed for existing habitats. The fixed guideway alignment also passes through a floodplain between I-29 and KCI Airport. The I-29 fixed guideway alignment would have similar impacts as the I-29 roadway widening improvements.

Table 15 identifies the significant natural resource impacts to the initial strategies.

Table 15
Natural Resource Impacts

Alternative Strategy		Natural Resource Impacts
1	Base Condition	Base
2	Low Capital Improvements	None
3	Travel Demand Management	None

4	Highway Capacity Improvements • Option A – Existing Facilities • Option B – New Facilities	**Option A Existing Facilities.** River crossings may impact wetland/floodplain north of river and Pallid Sturgeon species. US 169, Route 9 and I-29 cross several floodplains. **Option B New Facilities.** Wetland/floodplain impacted off levee, west of Downtown Airport for new facility. New facility off Route 283 crosses two floodplains.
5	Alternative Route Highway Capacity Improvements	Unknown
6	Expanded Bus Service	Unknown
7	High-Occupancy Vehicle Lanes	River crossings may impact wetland/floodplain north of river and Pallid Sturgeon species. US 169 and I-29 cross several floodplains. I-35 crosses floodplain just north of I-29. Route 9 lies adjacent to a wetland and a floodplain, west of US 169.
8	Bus Rapid Transit • KCI to Downtown via I-29 Alignment • KCI to Downtown via Master Plan Alignment • I-29/Waukomis to Downtown	**KCI to CBD, I-29 Alignment.** I-29 river crossing may impact wetland/floodplain north of river and Pallid Sturgeon species. I-29 alignment crosses several floodplains including at KCI Airport. **KCI to CBD, Master Plan Alignment.** River crossing may impact wetland/floodplain north of river and Pallid Sturgeon species. This alignment may also impact the Indiana bat species. The Master Plan alignment crosses several floodplains especially near the Water Well/Water Works Park area and adjacent to Line Creek, including at KCI Airport. **I-29/US 169 to CBD.** River crossing may impact wetland/floodplain north of river and Pallid Sturgeon species. The Master Plan alignment crosses floodplains located near the Water Well/Water Works Park area and south of I-29.
9	Light Rail Transit	Same as Strategy 8
10	Commuter Rail	None

Hazardous Waste Sites

The majority of the hazardous waste sites identified within the Study Area are located in North Kansas City and Downtown Kansas City. Improvements along Route 9 or Swift may impact numerous hazardous waste sites. There are also a number of sites identified along Grand Boulevard, north of I-70. US 169 and I-29 also have several sites located along those corridors. The proposed facility connecting I-29 with Route 210 may impact several sites identified along the corridor.

The nature of the hazardous waste sites will have to be identified in order to fully determine the extent of the impact these improvements may have. Table 16 identifies the significant hazardous waste site impacts to the initial strategies.

Table 16
Hazardous Waste Sites

Alternative Strategy		Hazardous Waste Site Impacts
1	Base Condition	Base
2	Low Capital Improvements	None
3	Travel Demand Management	None
4	Highway Capacity Improvements • Existing Facilities • New Facilities	**Existing Facilities.** Numerous hazardous waste sites located along Route 9 corridor in North Kansas City. Several sites located along US 169 and I-29. **New Facilities.** Few sites identified, except for several sites along new facility connecting I-29 and Route 210.
5	Alternative Route Highway Capacity Improvements	None
6	Expanded Bus Service	None
7	High-Occupancy Vehicle Lanes	Several sites identified along US 169 and I-29.
8	Bus Rapid Transit • KCI to Downtown via I-29 Alignment • KCI to Downtown via Master Plan Alignment • I-29/Waukomis to Downtown	**KCI to CBD, I-29 Alignment.** Several sites identified south of the river and along I-29. **KCI to CBD, Master Plan Alignment.** Several sites identified south of the river. Numerous sites along Burlington or Swift and a few identified between Route 152 and 112th Street. **I-29/US 169 to CBD.** Several sites identified south of the river. Numerous sites along Burlington or Swift.
9	Light Rail	None
10	Commuter Rail	None

Cultural Resources

Improvements along Grand Boulevard, as shown in Strategy No. 8 and 9, Fixed Guideway Transit may have potential impacts on the Old Town Historic District located west of Grand and north of I-70. A new river crossing along the Grand Boulevard alignment (Master Plan alignment) may have potential impacts on the Town of Kansas Archaeological site. No other impacts to cultural resources could be determined based on the current alternative strategies.

Parklands

The areas located just north and south of the Missouri River are designated as proposed parks in the Kansas City Missouri Board of Parks and Recreation 1993 Plan. Any proposed river crossing improvement may impact these areas. US 169 and Route 9 both cross a proposed park that would connect the Water Well and Water Works Parks, and both roadways also cross Briarcliff Parkway. Route 9 lies adjacent to a proposed park and Water Well Park, west of the US 169 interchange. Sections of US 169 are proposed as a future parkway. I-29 runs adjacent to West Terrace Park, on the west side of the downtown loop, Belvidere Park, at the Paseo interchange, North Hills Park, north of Armour Road, and Northgate Park north of the I-29/I-35 split. I-29 also crosses Riverfront Parkway, the proposed parkway along Parvin Road, the proposed Line Creek Parkway, and Tiffany Springs Parkway.

The proposed facility along the levee, on the west side of the Downtown Airport, is a proposed parkway alignment and may also impact the proposed park between the levee and the Missouri River. The proposed facility that would connect Route 283 with I-29 crosses through the Riverview Greenway and North Hills Park.

Any fixed guideway alignment along the Line Creek Corridor may have impacts on the proposed Line Creek Parkway, as well as several existing and proposed parks along the corridor. This alignment may also have potential impacts of proposed parkway crossings at NW 56th Street and Barry Road. The Master Plan Alignment also passes through the Water Well/Water Works Park area and crosses Briarcliff Parkway. The fixed guideway transit alignments may also impact the existing park within the median of the KCI Airport entrance.

Table 17 identifies the significant parkland impacts to the initial strategies.

Table 17
Parkland Impacts

Alternative Strategy		Parkland Impacts
1	Base Condition	Base
2	Low Capital Improvements	None
3	Travel Demand Management	None

4	Highway Capacity Improvements • Existing Facilities • New Facilities	**Existing Facilities.** River crossings may impact proposed parks just north and south of river. US 169 and Route 9 cross through the Water Well/Water Works Park area, and I-29 runs adjacent to several park areas. Sections of US 169 are proposed parkways, and also crosses Briarcliff Parkway. I-29 crosses several existing and proposed parkways. **New Facilities.** River crossings may impact proposed parks just north and south of river. Levee around west side of Downtown Airport is proposed parkway adjacent to proposed park. New facility connecting Route 283 to I-29 crosses 2 parks.
5	Alternative Route Highway Capacity Improvements	None
6	Expanded Bus Service	None
7	High-Occupancy Vehicle Lanes	River crossings may impact proposed parks just north and south of river. US 169 crosses through the Water Well/Water Works Park area, and I-29 runs adjacent to several park areas. Route 9 lies adjacent to a proposed park and Water Well Park, west of US 169. Sections of US 169 are proposed parkways and US 169 and Route 9 both cross Briarcliff Parkway. I-29 alignment crosses several existing and proposed parkways.

8	Bus Rapid Transit • KCI to Downtown via I-29 Alignment • KCI to Downtown via Master Plan Alignment • I-29/Waukomis to Downtown	**KCI to CBD, I-29 Alignment.** River crossing may impact proposed parks just north and south of river. I-29 alignment runs adjacent to several park areas including median of KCI Airport entrance. This alignment also crosses a few existing and proposed parkways. **KCI to CBD, Master Plan Alignment.** River crossing may impact proposed parks just north and south of river. The Master Plan alignment crosses through the Water Well/Water Works Park area and several existing and proposed parks adjacent to Line Creek, including median of KCI Airport entrance. This alignment runs along the proposed Line Creek Parkway alignment, and also crosses a few other existing and proposed parkways. **I-29/US 169 to CBD.** River crossings may impact proposed parks just north and south of river. The Master Plan alignment crosses through the Water Well/Water Works Park area and Briarcliff Parkway.
9	Light Rail Transit	Same as Strategy 8
10	Commuter Rail	None

3.4 Community and Development Impacts

In conjunction with City of Kansas City Planning Staff a set of criteria for evaluating each of the strategies was developed. Each of the strategies has implications on existing and proposed land use in the corridor. The criteria rely on the City's comprehensive plan, FOCUS, (specifically the Northland FOCUS Plan) as a framework and three general goals identified earlier in the study related to land use:

- The most successful strategy(ies) encourage redevelopment of existing sites and "infill" development. They also encourage contiguous development at higher densities in strategically located centers as defined in the Northland FOCUS Plan.

- The most successful strategy(ies) promote development of the Kansas City International Airport employment center.

- The most desirable strategy(ies) promote neighborhood viability, access to different transportation modes to all residents and encourage the development of stronger east/west connections.

Any transportation strategies that serve existing population centers, expand other modes to populations most likely to use them, get all modes across the river faster than in a single occupancy vehicle and begin to develop multi-modal centers, however modest, are desirable. At the same time transportation strategies must support the desired change in development pattern. It is important to note, in addition, that changing land development policies are also important in changing development patterns from the current sprawling configuration to something more compact. The criteria fell into three general categories:

- Development Opportunities
- Neighborhood Preservation and Connections
- Improvement of Non-motorized River Crossing Opportunities

Development Opportunities

This criteria measures the extent to which a strategy encourages development consistent with existing strategic plans, the extent to which it supports development of identified employment zones, and the degree to which a specific strategy offers joint development opportunities.

In the I-29 corridor north of the Missouri River, three strategic, proposed, high density locations occur within priority development zones. They are Airworld Center/Executive Hills, Barrybrook/Barry Crossing and Tremon/Picture Hills. It is important that transportation improvements in the corridor support the further development of these centers. In particular, the Airworld Center and Executive Hills areas are significant Northland employment centers. Improvements in the corridor should improve access to these areas providing an easy commute from downtown to the businesses within Airworld and Executive Hills as well as those commuters originating north of the river.

Transportation improvements, especially those related to LRT and BRT typically generate development opportunities which can change the pattern of development in the Northland from its current sprawling character to something more compact and of higher density. This is an objective of the City's comprehensive plan. The extent to which a particular strategy results in an investment in the transportation system that has an opportunity to spur companion, private investment or to leverage private investment makes it more desirable in this category.

Neighborhood Preservation and Connections

This criteria measures two attributes of each strategy. The extent to which it links neighborhoods together, or increases the potential for linking neighborhoods and the extent to which the strategy provides convenient neighborhood access to all modes of transportation. These criteria also include an evaluation of the degree to which a strategy increases the potential for improved east/west movement and whether or not the strategy disrupts existing neighborhoods. In addition, those strategies that increase feeder routes and encourage access to the centers identified above rank higher in the evaluation.

3.4.3 Improve Non-Motorized River Crossing Opportunities

Finally, it is important that highest ranking strategies improve the capacity for bicycle and pedestrian facilities to cross the Missouri River.

3.4.4 Strategy Evaluation

The conceptual strategies evaluation matrix shows the results of the subjective analysis in the category of land use for each of the strategies (see Table 24). The table was completed with the help of City of Kansas City Planning staff and the Advisory and Steering Committees. Generally speaking, strategies 1-5 or the "automobile oriented" strategies, have the least favorable impact on community land use objectives. However, of these, the Low Capital Improvement, Strategy No. 2 showed the greatest rating.

Improvement of mass transit including expansion of bus service, and development of LRT and/or BRT have the most positive impact. Policy initiatives such as TDM, identified in Strategy No. 3 also have the potential to change land use patterns. It is important, however, to implement such policies on a regional basis. Otherwise the measures may be seen as disincentives to development in the area in which they are applied.

Strategy No. 6, Expanded Bus Service ranked relatively high because it increases the access to public transportation within existing concentrations of population. In addition, the development of modest transit centers consistent with the FOCUS center locations work toward future higher densities. At the same time, however, the impermanent nature of bus service does not readily change development patterns.

The two most favorable options from the evaluation are the fixed guideway strategy of LRT and BRT running from downtown to KCI along what is known as the Master Plan alignment, and the LRT and BRT option which runs from the I-29/US 169 split to downtown.

The Master Plan alignment assumes the development of an integrated feeder bus route system and stands the best chance of any strategy in the I-29 corridor for changing development patterns. The Line Creek Valley is largely undeveloped and the possibility exists for a higher density center along the alignment. The newer technology and prospect of a permanent facility has greater potential for attracting the investment needed to change the current, low density development pattern. It is important to note however, that changes in development are more likely to happen with actual purchase of ROW by the KCATA rather than simply corridor preservation through the planning process.

LRT/BRT from the I-29/US 169 split to downtown is a desirable option from a land use perspective. This option keeps the enhanced transportation system south of the I-29/169 split. It stands to increase the redevelopment and infill potential at the split and provides greater transportation choice at the highest existing population concentration. This strategy also allows for the phase in of LRT and BRT. At the same time, this strategy encourages the development of a much-needed feeder route system on a smaller scale. There is little disruption of existing neighborhoods and mobility across the river is enhanced.

3.5 Financial Impacts

Preliminary capital and operating costs for the improvement strategies are presented in this section. Capital and operating costs have been developed as part of the cost-effectiveness determination for the initial strategy evaluation and selection.

Capital Costs

Roadway

The benefits of increased roadway improvements require an investment of resources. Table 18 shows the estimated capital cost for roadway improvements.

At this preliminary stage of analysis, there is considerable uncertainty about specific aspects of what the roadway improvements would entail in addition to physical limitations of the improvements. Thus, a range of anticipated order-of-magnitude costs are shown. More detailed planning and engineering would be required to narrow the range of uncertainty.

Table 18
Roadway Capital Cost Estimates
(Million 1999 Dollars)

Alternative Strategy		Roadway Capital Cost
1	Base Condition	Base
2	Low Capital Improvements	$10 - $30
3	Travel Demand Management	$0
4	Highway Capacity Improvements • Option A – Existing Facilities • Option B – New Facilities	 $240 - $410 $210 - $330
5	Alternative Route Highway Capacity Improvements	Unknown
7	High-Occupancy Vehicle Lanes	$200 - $280

Transit

The benefits of increased transit service also require an investment of resources. That investment would be very substantial for the fixed guideway transit alternatives. To support the preliminary screening process, estimates were developed for three BRT and LRT options:

- KCI to downtown using an alignment along I-29 north of the I-29/US 169 split
- KCI to downtown using the Master Plan alignment
- A “starter line” from I-29 and Waukomis to downtown

The results are shown in Table 19. At this preliminary stage of analysis, there is considerable uncertainty about how much the fixed guideway transit alternatives are likely to cost. Thus, a range of anticipated order-of-magnitude costs are shown. More detailed planning and engineering would be required to narrow the range of uncertainty.

The capital cost is affected substantially by the transit mode. The LRT alternatives can be expected to be the most expensive of the transit alternatives, and cost 50 percent to 100 percent more than a BRT facility of comparable length.

Table 19
Transit Capital Cost Estimates
(Million 1999 Dollars)

Alternative Strategy		Transit Capital Cost
1	Base Condition	Base
6	Expanded Bus Service	$10 - $30
8	Bus Rapid Transit • KCI to CBD via I-29 Alignment • KCI to CBD via Master Plan Alignment • I-29/Waukomis to CBD	 $340 - $470 $360 - $500 $120 - $160
9	Light Rail Transit • KCI to CBD via I-29 Alignment • KCI to CBD via Master Plan Alignment • I-29/Waukomis to CBD	 $530 - $720 $560 - $790 $220 - $300
10	Commuter Rail	$12 - $24

The alignment for a fixed guideway transit facility does not substantially affect the capital cost estimate. Decisions between the I-29 alignment and the master plan alignment would be based on factors other than cost.

These cost estimates are consistent with the actual construction costs of other LRT and BRT systems across the U.S. Tables 20 and 21 compare the Northland estimates with recent similar projects in terms of the capital cost per mile. A Northland project would be more expensive than some of these projects because there is no existing available right-of-way, such as an abandoned railroad. A Northland project is also likely to entail a new crossing of the Missouri River. However, it is less expensive than some others that involve tunneling.

Table 20
BRT Cost Comparisons
(Million 1999 Dollars)

Project	Capital Cost per Mile
Miami (South Miami-Dade)	$5
Orlando (Lymmo)	$7
Kansas City Northland	**$18 - $26**
Pittsburgh (MLK Extension)	$27
Pittsburgh (Airport)	$54
Cleveland (Euclid)	$58

Table 21
LRT Cost Comparisons
(Million 1999 Dollars)

Project	Capital Cost per Mile
St. Louis (St. Clair)	$19
Denver (Southwest)	$20
Salt Lake City	$21
Kansas City Northland	**$28 to $48**
San Jose (Tasman)	$45
Portland (Westside)	$54
New Jersey (Hudson-Bergen)	$103

The Advisory Committee requested additional information on the capital cost of the fixed guideway transit strategies. The study team was asked to provide separate cost estimates for the LRT and BRT options. Appendix B provides a summary of the capital cost estimates.

Funding for the transit alternatives has not yet been identified. Any of the fixed guideway transit alternatives are likely to require a new source of State and/or local funding.

Operations and Maintenance Costs

Roadway

Operating and Maintenance (O&M) costs for roadway improvements are based on the MoDOT historical average cost of around $9,000 per annual lane mile. The expansion of roadway improvements would lead to increases in the cost of operating and maintenance of the roadway system. An order-of-magnitude estimate of the likely operating and maintenance costs are shown in Table 22.

Table 22
Change in Roadway Operating and Maintenance (O&M) Costs
(Million 1999 Dollars per Year)

Alternative Strategy		Change in Transit O&M Costs
1	Base Condition	Base
2	Low Capital Improvements	$0.3 – $0.5
3	Travel Demand Management	$0.3 – $0.5
4	Highway Capacity Improvements	$0.3 – $1.0
5	Alternative Route Highway Capacity Improvements	Unknown
7	High-Occupancy Vehicle Lanes	$0.3 – $1.0

Transit

The expansion of transit service would lead to increases in the cost of operating and maintaining transit service. Such costs include the cost of labor to operate and maintain the vehicles, as well as fuel or power to operate the vehicles. An order-of-magnitude estimate of the likely operating and maintenance costs are shown in Table 23.

Table 23
Change in Transit Operating and Maintenance (O&M) Costs
(Million 1999 Dollars per Year)

Alternative Strategy		Change in Transit O&M Costs
1	Base Condition	Base
6	Expanded Bus Service	$2 – $3
8	Bus Rapid Transit • KCI to CBD via I-29 Alignment • KCI to CBD via Master Plan Alignment • I-29/Waukomis to CBD	 $10 – $12 $10 – $12 $4 – $6
9	Light Rail Transit • KCI to CBD via I-29 Alignment • KCI to CBD via Master Plan Alignment • I-29/Waukomis to CBD	 $10 – $12 $10 – $12 $4 – $6
10	Commuter Rail	$1 – $2

To some degree, the increase in transit O&M costs will be offset by increases in transit fares, as improved service leads to higher ridership. The percentage of O&M costs covered by fares is referred to as the farebox recovery ratio. In 1997, the KCATA had a farebox recovery ratio of 19 percent. If transit service were to be significantly expanded in the Northland, additional State and/or local funding would be required to cover that part of the increased O&M costs that could not be met out of the farebox.

3.6 Overall Strategy Evaluation Summary

The overall strategy evaluation summary presents the assessment of the strategies in meeting the goals of the study. Each strategy was analyzed as to its individual impacts and merits, and was then compared to the Base Condition strategy. The four major investment study goals of effectiveness, cost effectiveness, financial feasibility and equity help identify the strategies that warrant further, more detailed study in Phase II. Table 24 shows the evaluation of all evaluation factors for each strategy evaluated.

Effectiveness

The issue of effectiveness addresses the determination of the ability of the strategies to meet the study goals. These goals have been formulated in coordination with the region's initiatives as articulated in MARC's Long-Range Transportation Plan. These goals provide the framework for assessing the need for investments to improve the transportation system, economic opportunities, air quality, and other local transportation-related issues. Effectiveness goals addressed in this study are System Preservation, Personal Mobility and Quality-of-Life, Land Use and Development, Regional Economy, Safety and System Management and Efficiency.

System Preservation

System preservation represents the effectiveness of each strategy in using existing infrastructure (i.e. previous capital investments such as pavement and bridges) as well as evaluating the constructability of each strategy.

The percent of lane-miles that that can provide major roadway rehabilitation were evaluated. Only two strategies provided a system preservation benefit. Strategy No. 4, Highway Capacity Improvements and Strategy No. 7, High-Occupancy Vehicle Lanes would provide a cost savings for system preservation. Similarly, only these same two strategies would provide a benefit for bridge replacement savings.

Maintenance of traffic (constructability) identifies the ability to provide the improvement to the public in a manner that would not seriously deteriorate existing travel conditions. The constructability was rated for each strategy and the results identified that some strategies would have no negative impact on motorists. These strategies include Strategy No. 3, Travel Demand Management; Strategy No. 6, Expanded Bus Service; and Strategy No. 10, Commuter Rail. Strategies that would have little affect on existing traffic would be Strategy No. 2, Low Capital Improvements and Strategy No. 4, Highway Capacity Improvements - Option B, New Facilities.

Personal Mobility & Quality-of-Life

Personal mobility identifies the effectiveness in improving motorists travel times and reducing their travel distance. In addition, the ability to improve alternative transportation modes such as transit ridership within the Study Area. Quality-of-life factors identified include air quality, noise quality, energy consumption as well as natural and historic resources.

Personal Mobility

Significant decreases in motorists travel time and travel distance are a result of elimination of congestion points, bypasses of congestion and increased capacity to handle vehicle demand. A significant personal mobility benefit with physical capacity improvements to the primary Study Area roadways was provided with Strategy No. 4, Highway Capacity Improvements. Significant transit investment in the Study Area also has the ability to provide improved personal mobility. Transit Strategy No. 8, Fixed Guideway Transit (BRT) and Strategy No. 9, Fixed Guideway Transit (LRT) help provide improved personal mobility. All other strategies are expected to have little impact on overall motorists mobility.

Quality-of-Life

Quality-of-life impacts were analyzed by evaluating environmental issues to determine the extent to which strategies would impact the natural environment for residents in the Northland. Strategies that have the lowest impact on quality-of-life are strategies that have the least amount of capital investment. These strategies include Strategy No. 2, Low Capital Improvements; Strategy No. 3, Travel Demand Management; Strategy No. 6, Expanded Bus Service and Strategy No. 10, Fixed Guideway Transit (Commuter Rail). These strategies would impact the natural environment the least since they provide improvements within existing right of ways. The other strategies would have some varied impact on all aspects of the natural environment.

Land Use and Development

Land use and development has been organized into three primary considerations – development opportunities, neighborhood preservation/connections and improvement of non-motorized river crossings. As a subset to development opportunities, the ability of the strategy to encourage development that is consistent with strategic plans, support development of employment zones and promote joint development opportunities was evaluated. As a subset to neighborhood preservation/connections, the ability of the strategy to identify opportunities to link and support the viability of existing neighborhoods and provide convenient access to transportation alternatives was evaluated.

Transit improvements of expanded bus service, bus rapid transit and light rail transit had the greatest opportunity to positively impact development opportunities. Fixed transit improvements would encourage development around transit stations. This development pattern is consistent with current strategic planning in the Northland. In addition, transit improvements would help to link and support existing neighborhoods and provide a convenient alternative transportation alternative.

Regional Economy

The efficiency of Study Area streets and highways is an important component to the vitality of the regional economy. Efficient and accessible transportation plays an important role in the Northland economy. Measures of effectiveness of the transportation systems impact to the regional economy are calculated with travel time and access to freight facilities. Another major component of the transportation system and its impact on the Northlands economy is the three major river crossings. Providing an efficient and accessible link between areas north and south of the river is important to the Northland economy.

Travel times between KCI Airport and the downtown loop as well as the I-29/US 169 Interchange to the downtown loop were estimated and compared to automobile travel in 2020 under the Base Condition. As a result, transit improvements usually saw an increase in travel time compared to the Base Condition and roadway improvements, including high-occupancy vehicle lanes are expected to see an improvement in travel time.

Transit improvements were identified with a decrease in travel time since they are compared to automobile travel. This result, punctuates the fact that transit modes have a difficult time competing against other vehicle modes. Transit travel times are almost always longer than

equivalent automobile travel. This is one of the inherent difficulties when transit modes compete against automobile modes.

Safety

The health and safety of the public is of paramount concern in the planning, implementation and operation of transportation service and facilities. The measure used to analyze safety included the change in annual accidents in 2020 compared to the Base Condition. The safety of motorists in the Northland was determined by analyzing historical accident experience on Study Area highways. Accident rates (accidents per 100 million vehicle miles traveled) were calculated for highway sections. High accident rates are typically caused by congestion, inadequate geometric design, or a combination of the two. The only strategy that would both reduce congestion and improve substandard geometric features is the proposed roadway improvements to existing facilities in Strategy No. 4, Highway Capacity Improvements, Option A – Existing Facilities. Some of the other strategies would help provide some reduction in congestion to existing facilities but would not improve the existing, outdated elements of the system.

System Management and Efficiency

The efficiency of streets and highways is measured by motorists level of service. The percent change of highway lane miles and vehicle miles traveled was used. Transit rider efficiency is also measured to determined the transit system efficiency. This measure is the total change in passengers per mile.

As shown in Table 24, only Strategy No. 4, Highway Capacity Improvements, had a positive impact on system management and efficiency. Both Option A – Existing Facilities and Option B – New Facilities would have a positive impact on providing more lane miles and vehicle miles traveled at an acceptable service level compared to the Base Condition. Strategy No. 4, provides physical improvements that help reduce congestion for motorists in the Northland. The other strategies are not able to change travel demand enough to help Study Area service levels.

Cost Effectiveness

Cost-effectiveness addresses the extent to which the costs of the strategies are warranted based on their effectiveness in improving the transportation system's operations. This issue considers the efficiency of the capital investment. The costs are typically measured by the construction and O&M costs, including life-cycle cost considerations. Benefits typically include the value of improved system operations for the system users. These benefits typically represent improvements in travel times and accidents. The measure of effectiveness used to analyze cost effectiveness is represented with the cost per daily hour of travel time saved in 2020 compared to the Base Condition.

As shown in Table 24, Strategy No. 4, Highway Capacity Improvements, was the only strategy that provided a substantial improvement in travel time savings over the Base Condition, compared to the cost of the improvement. Transit improvements are not expected to provide a significant improvement in travel time between the users origin and destination since capital and operating expenses are very high.

Financial Feasibility

Financial feasibility addresses the ability of the region to afford the transportation investments. These funding considerations address both the initial capital investment for the construction of the improvements as well as the ongoing annual costs of operations and maintenance. Financial feasibility is identified by the capital costs of construction, the annual operating and maintenance (O&M) costs and the potential to receive immediate short-term benefits from implementation.

Table 24 identifies the capital and O&M costs associated with each strategy. Based on the costs of each strategy and the expected immediate benefits realized, highway build strategies along with enhancements to the existing bus system would provide the highest potential to immediate short-term benefits.

Strategies that provide low capital improvements, travel demand management and improvements to the existing bus system provided the greatest short-term opportunities and benefits to the transportation system. In addition, highway-build improvements such as Strategy No. 4 and Strategy No. 5 also provided some immediate short-term benefits. High capital cost and operating cost investments in light rail, bus rapid transit and commuter rail would not have as positive a short-term investment.

Equity

Equity addresses the proportionality of the costs, benefits and impacts of the transportation improvements within the various segments of the area's population. These equity issues consider the degree to which the improvements benefit or impact various socio-economic groups disproportionately.

Table 24 shows a rating of the physical avoidance of adverse impacts to minorities and low income populations. As shown in the table, all strategies had the highest rating possible. This means that each strategy did a good job of avoiding physical impacts to minorities and low income population neighborhoods.

4.0 Screening of Strategies

4.1 Strategies to Carry Forward

Based on the evaluation of potential strategies, the initial set of strategies was screened to include a number of strategies to carry forward into the more detailed phase of the study. Table 25 identifies the strategies being recommended for more detailed study.

Table 25
Initial Screening

Alternative Strategy		Carry Forward	Screened Out
1	Base Condition	■	
2	Low Capital Improvements	■	
3	Travel Demand Management	■	
4	Highway Capacity Improvements • Option A – Existing Facilities • Option B – New Facilities	■	■
5	Alternative Route Highway Capacity		■
6	Expanded Bus Service	■	
7	High-Occupancy Vehicle Lanes	■	
8	Bus Rapid Transit	■	
9	Light Rail Transit	■	
10	Commuter Rail		■

The initial strategies evaluation analyzed the initial strategies for their ability to improve travel for Northland motorists. Based on the evaluation in this technical memorandum, three strategies were screened out and not carried forward to the more detailed analysis phase. The three strategies dropped include:

- **Strategy 4A, Highway Capacity Improvements with New Facilities** – This strategy was screened out due to its inability to attract significant traffic demand to the new facilities to reduce demand along existing facilities. Physical constraints on existing facilities limit the ability of new facilities to provide significant regional travel improvements. New facilities would be costly to build an have significant environmental impacts.

- **Strategy 5, Alternative Route Highway Capacity** – This strategy was screened out due to its inability to attract significant traffic demand to the alternative routes. The improvements provided little benefit to study area motorists for reduction of travel distance and travel time savings.

- **Strategy 10, Commuter Rail** – This strategy was screened out because it only attracted between 230 and 600 new riders a day in comparison to the $12 to $24 million cost.

4.2 Arrangement of Alternatives

Strategies described above all have unique benefits and costs associated with them. It is unlikely that a single strategy is the best solution for the Northland. Consequently, combinations of the above strategies are recommended to maximize the benefit/cost ratio for the entire Northland Study Area. Combination strategies proposed are based on alternative strategies that have a strong benefit/cost ratio individually and strategies that compliment one another. Table 26 shows the recommended strategy combinations to be carried further into more detailed analysis of the benefits and costs to the Northland Study Area.

NORTHLAND

DOWNTOWN

MAJOR INVESTMENT STUDY

Appendix A

Study Goals and Objectives

Appendix A
Study Goals and Objectives

MIS Goals	LRTP Goals	Objectives
Effectiveness	*System Preservation*	• *Maintain and/or prolong the useful life of existing elements of the street, highway and transit systems.*
	Personal Mobility & Quality-of-Life	• *Ensure that transportation corridors serve all modes for which there is travel demand, or for which demand could be anticipated in a fully developed system.* • *Encourage alternatives to single occupancy vehicle (SOV) transportation.* • *Make transit easier to access.* • *Seek to maintain or improve environmental quality & encourage the efficient use of energy & natural resources.* • *Protect sensitive natural resources such as stream corridors, floodplains, woodlands and steep slopes.*
	Land Use and Development	• *Encourage redevelopment of existing areas, new development contiguous to existing development, and development at higher densities.* • *Promote development of the KCI Airport area and Birmingham Bottoms as employment centers.* • *Promote neighborhood identity in the Northland and enhance physical connections between the neighborhoods.*
	Regional Economy	• *Enhance the region's position as an intermodal center for freight shipment and as a hub for intercity passenger transportation.* • *Provide adequate connections between regional activity centers.* • *Enhance connections across the Missouri River between Kansas City and Northland.*
	Safety	• *Increase Security in transit systems and safety of all users, regardless of mode.* • *Promote & Implement transportation system improvements that minimize the occurrence & severity of accidents.*
	System Management & Efficiency	• *Provide for all regionally significant roadways to operate at or above level of service "D".* • *Provide for transit system operations at acceptable standards.*
Cost Effectiveness		• *Support activities which are most likely to be cost effective.*
Financial Feasibility	*Funding*	• *Select alternatives that have a reasonable change of being funded.*
Equity		• *Seek out & address the needs of those who are underserved by the existing transportation system.*

NORTHLAND

DOWNTOWN

MAJOR INVESTMENT STUDY

Appendix B

Capital Cost Estimates

Strategy No. 8 and 9 – Fixed Guideway Transit

LRT/BRT

Capital Cost Estimates
Strategy No. 8 and 9 – Fixed Guideway Transit
LRT/BRT

July, 1999

1.0 Introduction

The Advisory Committee requested additional information on the capital cost of the fixed guideway transit strategies. The study team was asked to provide separate cost estimates for the LRT and BRT options. In addition, questions were raised about the rail cost estimates.

2.0 Cost Estimates by Mode

The table below provides an order of magnitude capital cost estimate for LRT and BRT under Options A1, A2, and A3. Key assumptions underlying these preliminary estimates include:

- Leaving downtown, both the LRT and the BRT alignments cross the Missouri River on a separate structure immediately east of the Heart of America Bridge and follow Burlington to the 32nd Street area (i.e., Water Works Plant). The transit facility is built at grade and generally within the existing right-of-way, displacing one of the existing lanes (either a travel lane or a parking lane) in each direction.

- From the 32nd Street area to the I-29/US169 Split, the alignment is located along the US 169 right-of-way.

- From the Split to KCI, the Option A1 LRT and BRT would either be built within the median of I-29 and Cockingham Drive or along the outside shoulder of the driving lanes. On-line stations (some with park-and-ride) would be placed about 1½ miles apart, on average.

- North of the Split, the Option A2 alignment for both LRT and BRT would generally follow the Line Creek Parkway up to the vicinity of Route 152. The alignment would then transition through the old Executive Hills Development Area to the I-29 Corridor at the 112th Street Interchange. This alignment is consistent with the route currently adopted by the City of Kansas City, Missouri Major Street Plan.

- North of the Split, the BRT facility would carry two-way traffic and would generally have a cross-section that is 32 feet wide (two 12-foot lanes plus two 2-foot shoulders, separated from general traffic by a concrete barrier). The cross-section would be wider at stations to allow for passing. With this design, HOV traffic would not be allowed to use the bus lanes.

These assumptions were made for early, conceptual level planning only. Other options may be considered in future planning and project development.

Preliminary Cost Estimates for Fixed Guideway Transit Options

	Option A1 KCI to Downtown I-29 Alignment		Option A2 KCI to Downtown Master Plan Alignment		Option A3 I-29/US169 Split to Downtown Burlington Alignment	
	LRT	BRT	LRT	BRT	LRT	BRT
Capital Cost (million 1999$)	$530-$740	$330-$470	$560-$800	$350-$500	$215-$320	$110-$160
Length (miles)	18.6	18.6	19.8	19.8	6.2	6.2
Capital Cost per Mile	$28.5-$39.8	$17.7-$25.3	$28.3-$40.4	$17.7-$25.3	$34.7-$51.6	$17.7-$25.8

3.0 Comparison with Other Cities

The following tables show that these estimates are consistent with the range of experience elsewhere in the country. For LRT, the table below shows the capital cost and the cost per mile for similar systems that are currently under construction or recently completed elsewhere in the U.S. For BRT, there are fewer construction cost experiences to draw from, so the comparison includes projects that are in the preliminary engineering and planning phases. Except as noted, the estimates shown here represent the cost of all project elements including:

- Civil (grading, track, structures)
- Systems (signals, electrification fare collection equipment, and controls)
- Stations and parking
- Vehicles
- Yard and shop
- Right-of-way
- Engineering, construction management and other agency costs, contingency

LRT Capital Costs: Comparison with Other Cities

City (Project)	Denver (Southwest)	*No. New Jersey* (Hudson-Bergen)	Portland (Westside)	Salt Lake City (South)	San Jose (Tasman Phase 1)	St. Louis (St. Clair)
Status	Under Construction	Under Construction	Opened in 1998	Under Construction	Under Construction	Under Construction
Capital Cost (million $)	$176	$992	$964	$313	$343	$339
Length (miles)	8.7	9.6	17.7	15	7.6	17.4
Cost per Mile (million $)	$20	$103	$54	$21	$45	$19

BRT Capital Costs: Comparison with Other Cities

City (Project)	Charlotte (Independence)	Cleveland (Euclid)	Miami (South Miami-Dade)	Orlando (Downtown Lymmo)	Pittsburgh (M.L. King Extension)	Pittsburgh (Airport/ West)
Status	MIS Complete	Preliminary Engineering	Operating	Operating	Final Design	Construction
Capital Cost (million $)	$126	$327 (a)			$62.8 (b)	$327 (b)
Length (miles)	13.5	5.6	8.2		2.3	6.1
Cost per Mile (million $)	$9.3	$58.4			$27.3	$53.6

(a) Cost estimate includes the relocation and renovation of existing rail stations, in addition to BRT
(b) Vehicles not included in cost

Initial Strategies Definition Technical Memorandum

March, 1999

1.0 Introduction

The following technical memorandum provides a summary of the initial strategies outlined for Phase 1 of the Northland~Downtown study. Phase 2 of the study combined the initial strategies into combination alternatives for more detailed evaluation.

This report documents the identification and screening of transportation investment strategies considered for application within the Study Area. Based on the definition of current and projected problems within the Study Area, a multi-modal set of initial strategies was identified. These strategies were then evaluated based on their respective potential impacts and benefits. Strategies without viable benefits or with unacceptable costs and impacts were screened out to narrow the applicable strategies for further, more detailed analysis. The initial set of strategies identified for the Northland~Downtown MIS are shown in Table 1.

Table 1
Initial Strategies

Strategy Number	Strategy Description
No. 1	Base Condition
No. 2	Low Capital Improvements
No. 3	Travel Demand Management (TDM)
No. 4	Highway Capacity Improvements • Option A – Existing Facilities • Option B – New Facilities
No. 5	Alternative Route Highway Capacity Improvements
No. 6	Expanded Bus Service
No. 7	High-Occupancy Vehicle Lanes
No. 8	Fixed Guideway Transit (BRT)
No. 9	Fixed Guideway Transit (LRT)
No. 10	Fixed Guideway Transit (Commuter Rail)

The initial strategies all have unique benefits and costs associated with them. It is unlikely that a single strategy is the best for the entire Northland area. Consequently, combinations of the above strategies could be identified in order to maximize the benefits and costs for the Study Area.

2.0 Problem Definition

One of the key components of the Major Investment Study (MIS) process is the identification of specific transportation-related problems within the defined Study Area. Through the understanding of the area's problems, investment strategies may be defined to specifically address the problem areas.

Based on existing and projected travel demands and the ability of the existing transportation system to serve these demands, transportation-related problems within the Study Area were identified in the *Problem Definition Summary,* dated March 1999. In addition to these demand-related problems, regional goals and objectives were identified from which current and projected system performances were evaluated. Analysis of these problems were performed to understand more definitively the nature and extent of the problems, as well as their underlying causes.

3.0 Definition of Potential Strategies

Based on the understanding of the current and projected transportation problems of the Northland, potential improvement strategies were developed for potential application. These strategies represent the initial list of reasonable and applicable strategies which are consistent with the current and projected travel and land use characteristics of the Study Area. Coordination with Mid-America Regional Council (MARC), the Kansas City Area Transportation Authority (KCATA) and the Missouri Department of Transportation (MoDOT), confirmed that those strategies to be studied are consistent with the region's long-range planning. Table I-1, Introduction, identifies the initial strategies studied, and each is defined in greater detail in this chapter.

The physical design standards for the improvement strategies consist of typical cross-sectional elements of a roadway which define the physical extent and space requirements of the facility. Typical cross-sectional elements are shown within each strategy description. Design criteria for a typical freeway and a typical interchange ramp were based on MoDOT design standards.

Exhibits of each of the following ten Initial Strategies are shown at the end of this technical memorandum.

3.1 Strategy No. 1 (Base Condition)

Description

The Base Condition Strategy consists of the existing plus committed (E+C) transportation system. Committed projects are those planned projects contained in MARC's Transportation Improvement Program (TIP), excluding the "placeholder" widening projects along I-29. In addition, outside the immediate Northland~Downtown MIS Study Area, the Base Condition Strategy includes selected projects in MARC's Long-Range Transportation Plan (LRTP) that would have an impact on travel within the KCI-Downtown corridor. The following improvements are included:

- Kansas City's and MoDOT's program of operational improvements at Broadway and 5th/6th Streets including intersection approach improvements, access management and signal upgrades.
- Chouteau Bridge and Front Street improvements.
- Four-lane Route 152 improvements east of I-29.
- Improve the I-29/Tiffany Springs Parkway Interchange.
- Construct a new half-diamond interchange at Route 152 and Executive Hills North.
- Bruce R. Watkins Drive south of the Downtown Freeway Loop.
- Phase 1 of Intelligent Transportation Systems (ITS) Early Deployment Plan.

Characteristics

Current highway facilities and bus transit service would be maintained, including the existing Antioch Transit Center. This strategy would include a regular program of pavement resurfacing, roadway reconstruction, bridge rehabilitation, and bus replacement.

Issues

- The performance analysis will show the transportation deficiencies that would occur if no infrastructure investments, other than currently planned investments, are made in the corridor.
- The Base Condition Strategy will serve as the baseline for evaluating the costs, benefits, and impacts of the "build" strategies.
- The Base Condition Strategy (and other strategies) will assume the development of an expanded and enhanced arterial street system as contained in MARC's LRTP.

3.2 Strategy No. 2 (Low Capital Improvements)

Description

A program of low capital improvements would be undertaken to enhance the operation and efficiency of the existing highway and transit systems. This strategy would include all facilities and services contained in the Base Condition Strategy plus, as appropriate, such improvements as:

- Improved signal coordination & operations along Broadway and Burlington.
- Local street improvements along NW 72nd Street west of Waukomis Drive and NW 56th Street between Waukomis Drive and I-29.
- Ramp metering on US 169 and I-29 south of the I-29/US 169 Interchange.
- Alternative route signing.
- Additional Intelligent Transportation System measures beyond Phase I, both highway and transit, including the management of alternative highway routes.
- Intersection improvements.
- Access management.
- Restructured bus service concept with increased service area, two new transit centers and expansion of the Antioch Transit Center.
- Park-and-ride lots.
- Pedestrian/bicycle facilities across the Missouri River using existing bridges.
- Implementation of the Clay County and Platte County Comprehensive Bike Plans.

Characteristics

The program of low capital improvements will be further defined and refined with the goal of optimizing the operation of the existing system. Highway investment will focus on the elimination of bottlenecks. The KCATA's fixed route bus transit system will be expanded, but will utilize essentially the current strategy of routes.

Issues

- Reversible lanes (without construction of new lanes) on US 169 and I-29 from the I-29/US 169 Interchange to Downtown would not be operationally feasible due to insufficient capacity (one lane) in the non-peak direction.
- The Low Capital Strategy will serve as a second baseline for evaluating the costs, benefits, and impacts of the higher capital "build" strategies.
- The improvements contained in this strategy will also be included, with appropriate modifications, in all of the higher capital "build" strategies.

3.3 Strategy No. 3 (Travel Demand Management, TDM)

Description

A program consisting of travel demand management (TDM) measures would be implemented to decrease vehicle trips through the use of programs and policies. TDM measures can also shift demand away from high peak periods to times where capacity is available. TDM improvements within the Northland~Downtown Study Area could include, but not be limited to:

- Increase ridesharing information and the implementation of park-and-ride facilities.
- Restructured bus service concept with increased service area, two new transit centers and expansion of the Antioch Transit Center.
- Encouragement of flextime for businesses in the Study Area.
- Telecommuting.
- Compressed workweek for businesses.
- Increased fees including parking fees and roadway user fees.
- More efficient land use, including the location of commercial, residential and business centers in closer proximity to one another.

Characteristics

The additional roadway capacity resulting from these measures would be beneficial for general traffic purposes. TDM measures will be defined with the objective of informing and educating the public about alternative schedules and mode choices that would further optimize the operation of the transportation system. Programs and policies to promote ridesharing, transit, flexible work hours, telecommuting and condensed work schedules will be considered.

Issues

- The practicality of making TDM a successful strategy is a major issue -- public support is vital to the success of TDM measures. The willingness of the public to incorporate schedule and mode choice alternatives into their daily travel schedule is a factor to be considered.

- Regional applications for TDM are a significant issue. Land use considerations, such as locating residential, commercial, and business centers in closer proximity to one another, could result in fewer, shorter trips and more efficient development patterns. For TDM strategies to be effective in the KCI-Downtown Corridor, they must be applied region-wide.

Business and institutional support for TDM is important to its success. It is essential that businesses located in the Study Area are willing to allow their employees to work flexible hours and condensed workweek schedules to decrease the congestion to the roadways during peak periods. Employer support would also be a necessary factor in encouraging their employees to rideshare.

3.4 Strategy No. 4 (Highway Capacity Improvements)

Description

This strategy will contain a package of highway capacity improvements within the Northland~Downtown Study Area such as roadway widening, major interchange improvements, and new highways, including expanded or new highway river crossings. The specific improvements to be included in this strategy will be selected after further study. This strategy would also include all facilities and services contained in the Base Condition Strategy plus, as appropriate, such candidate improvements as identified in the following two options:

Option A (Existing Facilities)

- I-29 Corridor – Add two general-purpose lanes on I-29 south of the I-29/US 169 Interchange providing a six-lane section, including expansion of the Paseo Bridge.
- US 169 Corridor - Due to insufficient space for typical widening capacity improvements, construct one reversible general-purpose lane on US 169 between the I-29 interchange and downtown, providing a five-lane section, including expansion of the Broadway Bridge.
- Burlington Avenue (Route 9) Corridor – Add two general-purpose lanes from North Oak Trafficway to 10th Avenue for improve through-put capacity, providing an eight-lane urban arterial section.
- Interchange improvements along US 169 and I-29 within the Study Area including:

    - I-29/I-635 Interchange – Improve lane balance and lane continuity.
    - I-29/US 169 Interchange – Improve lane balance and lane continuity.
    - I-29/Vivion Road Interchange – Improve ramp terminal capacities.
    - I-29/I-35 Interchange – Improve lane balance and lane continuity.
    - I-29/Route 210 Interchange – Reconfigure interchange to eliminate insufficient weave sections (SPUD or Directional).
    - I-29/Front Street/Paseo Interchange – Improve freeway weave sections and mainline lane balance and lane continuity.
    - US 169/Route 9 Interchange – Improve lane balance and lane continuity.
    - US 169/5th and 6th Street Interchange – Reconfigure interchange for improved operations (3-level diamond or Directional).

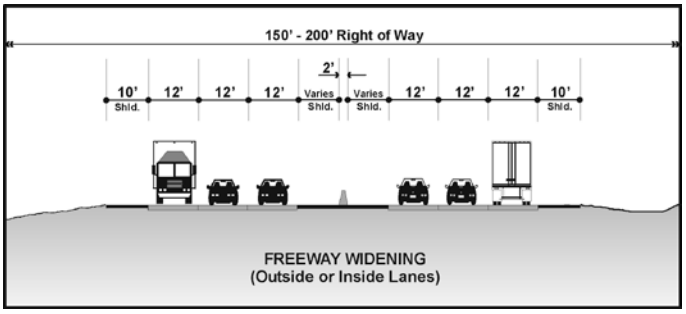
Option B (New Facilities)

- Construct a new east-west limited-access roadway between I-29 and North Oak Trafficway to better distribute traffic between the Paseo and Heart of America Bridges.
- Construct a new controlled-access freeway between I-29 and Route 210 to provide a freeway-to-freeway connection. Add two general-purpose lanes on I-29 south of the new Route 21 Connector Freeway providing a six-lane section along I-29 into Downtown, including expansion of the Paseo Bridge.
- Construct a new Missouri River crossing connecting US 169 near the Downtown Airport to I-35 northwest of downtown to bypass the Broadway/5th and 6th Street intersections. The alignment of the new river crossing's northern approach would have two options – one west of the Downtown Airport and one east of the Downtown Airport. The new river crossing approach roadways would consist of a controlled access freeway facility.
- Construct a new north-south limited-access roadway between I-70 and I-29 / I-35. One termini would be at the I-70 bend near Prospect and the other termini would connect near somewhere near the 16th Street Interchange. This roadway would have two interchange located at Front Street and Independence Avenue.

Characteristics

The additional roadway capacity represented by these improvements would be for general traffic purposes. The intent of the new east-west roadways would be to divert downtown-oriented traffic from I-29 and the Paseo Bridge to the underutilized Heart of America Bridge or to bypass the congested I-29/Route 210 Interchange. A new Missouri River crossing for US 169 would be considered to improve the operations and access to downtown for the existing Broadway Bridge.

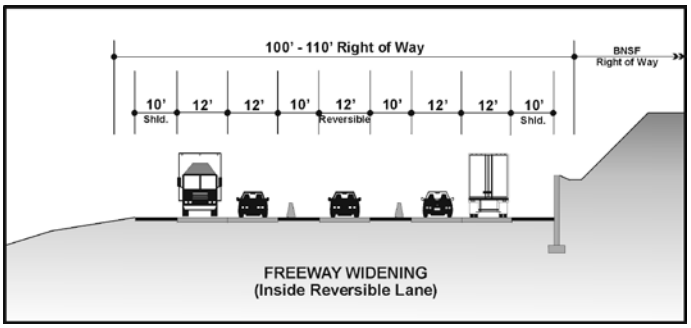
Option A (Existing Facilities)



Application:
- US 169 (I-29 to Route 9)
- I-29 (US 169 to Downtown)

Features:
- Widen one lane/direction inside or outside of existing pavement.
- May include reconstruction of existing pavement.

Costs:
- $5 to $6 Million/Mile



Application:

- US 169 (Route 9 to River)

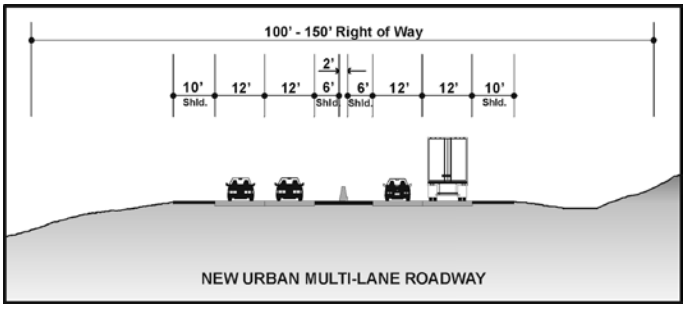
Features:

- No encroachment into BNSF right-of-way.
- Existing pavement would be reconstructed.
- Entry and exit gates for the reversible system would be required.

Costs:

- $12 to $15 Million/Mile

Option B (New Facilities)



Application:

- Connector (I-29 to N. Oak Trafficway)
- I-29/Route 210 Bypass
- Broadway Bridge Bypass

Features:

- Fully-controlled or partially-controlled access.
- Earthen embankment, retaining wall or viaduct.

Costs:

- $8 to $25 Million/Mile

Issues

- More than one highway improvement strategy may emerge from the preliminary analysis in order to provide for a more detailed and broader comparison between higher cost highway improvement alternatives.
- New roadways would potentially impact neighborhoods and environmentally sensitive areas. Routes that avoid or minimize adverse major impacts will need to be identified.
- The desire to provide freeway-type service for Route 210 traffic would determine the priority of the Route 210 Connector option.
- The acceptability of impacts to the Downtown Airport properties will determine the acceptability of the Broadway Bridge bypass options.

3.5 Strategy No. 5 (Alternative Route Highway Capacity Improvements)

Description

Strategy No. 5 would focus on highway investments which are outside the immediate Northland~Downtown Study Area, as defined, but which might divert traffic around the Broadway, Heart of America, and Paseo Bridges. This strategy would include all facilities and services contained in the Base Condition Strategy plus, as appropriate, the following two candidate alternative route corridors:

- ***Fairfax/7th Street Corridor*** - Expanded capacity of the Fairfax/7th Street Corridor including the Fairfax Bridge over the Missouri River (4-lane bridge).
- ***Chouteau/Front Street Corridor*** - Further improvements to the Chouteau Trafficway and Front Street including the planned Chouteau Bridge (6-lane bridge).

Characteristics

Alternative route improvements include general-purpose capacity investments such as roadway widening and enhanced signal coordination. For the Fairfax/7th Street Corridor, the alternative route is defined as improved connections between I-635 north of the Missouri River and Downtown, utilizing I-70, or I-35 south of Downtown. These connections are intended to provide improved alternative access to Downtown for downtown-oriented trips or I-35 for those trips destined to or originating from areas outside of the Urban Core. Capacity improvements to the Chouteau/Front Street Corridor would be beyond those currently planned in MARC's Long-Range Transportation Plan.

Issues

- Serious consideration of these alternatives would require an expanded participation process to bring in additionally affected interests.
- Potential impacts to alternative route roadways and adjacent areas would potentially impact neighborhoods and environmentally sensitive areas outside of the immediate Northland~Downtown Corridor. Improvements that avoid or minimize major adverse impacts will need to be identified.

3.6 Strategy No. 6 (Expanded Bus Service)

Description

Building on the restructured transit center concept and expanded bus service contained in Strategy No. 2, bus transit service within and north of the Study Area would be further expanded and enhanced. New bus service would be provided to areas currently not served including additional cross-town routes and the introduction of neighborhood circulators. To complement the three transit centers in Strategy No. 2, additional small-scale transit centers would be added to facilitate transfers between bus routes. This strategy would include all facilities and services contained in the Base Condition Strategy.

Characteristics

In addition to the new transit center concept, new bus service would be provided to areas north of the Study Area including Platte City along I-29 and Smithville along US 169. Smaller scale, neighborhood oriented transit centers would be included to provide comprehensive public transportation service throughout the Study Area. As warranted, express service to Downtown would be included.

Issues

- Roadway capacity improvements across the river would not be included with this strategy. Consequently, with the existing and projected capacity problems crossing the river, the effectiveness of this strategy to improve mobility to Downtown could be impeded.
- Considerations will need to be given to the financial implications of the ongoing operations and maintenance of this strategy.

3.7 Strategy No. 7 (High-Occupancy Vehicle Lanes)

Description

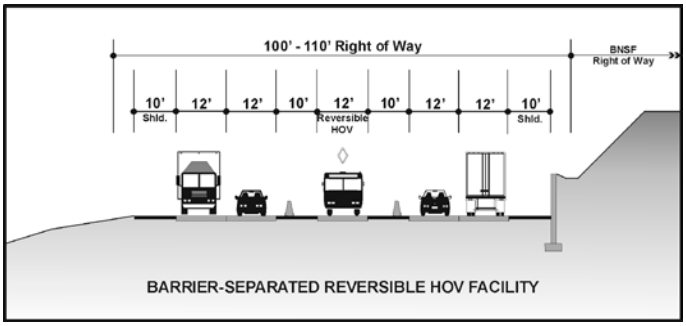
New exclusive use lanes would be added to US 169 or I-29 for High-Occupancy Vehicles (HOV) during peak periods. The HOV lanes would extend from the I-29/US 169 Interchange into Downtown, bypassing the most congested segments of the highway system. This alternative would include the bus system improvements in Strategy No. 2 and could also include additional park-and-ride facilities. Park-and-ride lots would be included at the terminals for the HOV system including the I-29/US 169 Interchange, I-29/I-35 Interchange and US 169/Route 9 Interchange areas. This strategy would include all facilities and services contained in the Base Condition Strategy.

Characteristics

A lower cost HOV system would be implemented including system options such as exclusive reversible or concurrent HOV lanes. Two candidate HOV corridors have been identified – US 169 and I-29. Based on the directional nature of commuter travel along US 169 and the tight physical constraints of the US 169 right-of-way, a barrier-separated reversible HOV system is planned – four general-purpose lanes and one reversible HOV lane. Moveable barriers would not be feasible due to the extensive bridge structures south of Route 9. The US 169 HOV system would extend from immediately north of I-29 to Downtown, including the replacement of the Broadway Bridge with a five-lane bridge. Exclusive HOV service into Downtown would be provided.

Along the I-29 Corridor, concurrent, non-separated HOV lanes located in the inside of the roadway would be provided. This HOV system would extend from immediately north of US 169 to downtown. The HOV lanes would be separated from the general purpose lanes by a paint stripe buffer rather than a physical barrier. The lanes could then be used by general traffic

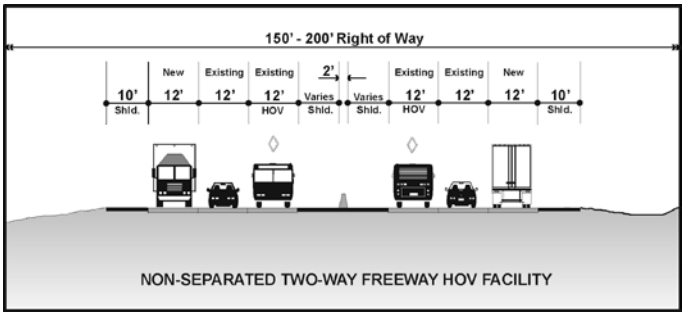
during off-peak travel periods. Additional capacity on the Paseo Bridge would be required to provide two HOV lanes and four general-purpose lanes.



Application:
- US 169 (Route 9 to River)

Features:
- No encroachment into BNSF right-of-way.
- Existing pavement would be reconstructed.
- Entry and exit gates for the reversible system would be required.

Costs:
- $13 to $16 Million/Mile



Application:
- US 169 (I-29 to Route 9)
- I-29 (US 169 to Downtown)

Features:
- Widen one lane/direction inside or outside of existing pavement and convert inside lanes to HOV.
- May include reconstruction of existing pavement.

Costs:
- $6 to $9 Million/Mile

Additional characteristics of the HOV system's operational plan include:

- **System Access Points and Priority Treatments** – Priority service would be provided for the southern terminus of the US 169 HOV system for a high-priority connection into Downtown, thereby queue-bypassing the 5th and 6th Street Interchange.
- **Hours of Operation** – Morning peak-hour period 7:00-9:00 a.m. and evening peak-hour period 4:00-6:00 p.m.
- **Vehicle Eligibility** – Two or more occupants.
- **Ramp Meter Bypass** – Queue bypasses would be provided at ramp metering locations.
- **Park-and-ride Lots** – Park-and-ride lots would be provided at the northern system terminal locations – Route 9, I-29, US 169 and I-35.

Issues

- Consideration will need to be given to a suitable access point to downtown, possibly including reserved lanes on the downtown street system.
- Coordination with a regional HOV system for HOV users not destined or originating from Downtown will need to be provided.
- Refinements of the expanded bus system to fully complement the high priority express service to Downtown will be required.
- Considerations will need to be given to the financial implications of the ongoing operations and maintenance of this strategy.
- Design provisions for HOV enforcement will need to be provided.

3.8 Strategy No. 8 (Fixed Guideway Transit, BRT)

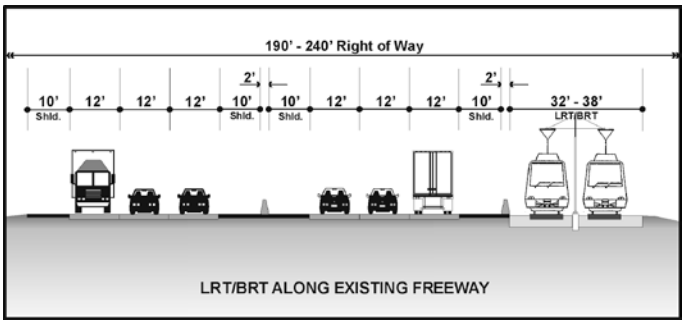
Description

This strategy would involve the construction of new fixed guideway transit improvements between KCI and Downtown, including the restructured transit center concept and expanded bus service contained in Strategy No. 2. Strategy No. 2 bus improvements would need to be refined to fully complement the fixed guideway system. This strategy would also include all facilities and services contained in the Base Condition Strategy. Candidate fixed guideway transit technologies include exclusive bus rapid transit (BRT), light rail transit (LRT) or commuter rail transit. Strategy No. 8 defines the BRT option.

Characteristics

Direct fixed guideway improvements would be provided between KCI and Downtown. The northern terminus would involve the construction of a new transit station connection at KCI. The southern terminal would entail a connection to existing or planned transit facilities in the downtown area, within the downtown freeway loop. Operational analyses will be developed with and without the completion of the Southtown Corridor LRT system south of Downtown. Intermediate on-line stations and associated park-and-ride lots would be provided as warranted. A new bridge crossing of the Missouri River would be provided due to the difficulties of widening the existing river bridges. Two BRT fixed guideway alignments are described as follows:

- **I-29 Alignment –** Located along and within the I-29 right-of-way from KCI to the I-29/US 169 Interchange, then an alignment along US 169 through North Kansas City either along US 169 or along the north-south arterial street system. A new crossing of the Missouri River near the existing Heart of America Bridge crossing would be provided. A connection into the Downtown area would entail a terminal station within the downtown freeway loop, or a connection to the Southtown Corridor LRT system.
- **Kansas City Major Street Plan Alignment –** Located within the emerging development areas along Executive Hills North Boulevard and Line Creek Parkway. South of the I-29/US 169 Interchange, the alignment would be located along US 169 with an alignment through North Kansas City along either US 169 or the north-south arterial street system. A new bridge crossing in the vicinity of the Heart of America would be required. A connection into the Downtown area would entail a terminal station within the downtown freeway loop, or a connection to the Southtown Corridor LRT system.



Application:

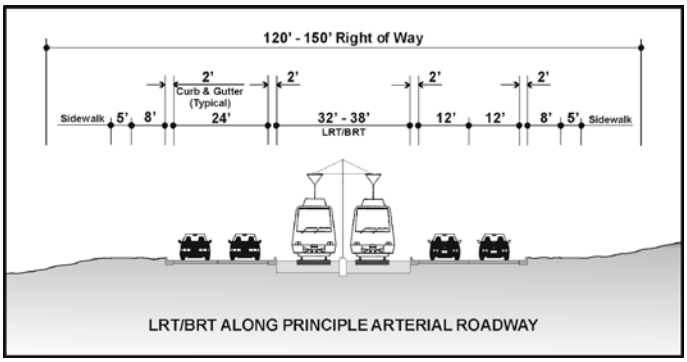
- I-29 Alignment along I-29.
- I-29 or Master Plan Alignment along US 169.

Features:

- Rapid transit corridor for either LRT or BRT.
- Two-way rapid transit operations.
- On-line stations would be provided at candidate crossroad interchange locations.

Costs:

- $17 to $35 Million/Mile



Application:

- I-29 or Master Plan Alignment along the arterial street system.

Features:

- Located within the middle or either side of roadway lanes.
- Two-way rapid transit operations.
- On-line stations would be provide at candidate locations, requiring additional width.

Costs:

- $13 to $28 Million/Mile

Issues

- Operational plan including service frequency and maintenance facilities.
- Bus service refinements to fully complement the fixed guideway system.
- Operational benefits with and without the implementation of the Southtown Corridor LRT system.
- Integration of fixed guideway improvements with the planned Johnson County Commuter Rail Pilot Project including the Union Station Intermodal Center.
- Considerations will need to be given to the financial implications of the ongoing operations and maintenance of this strategy.

3.9 Strategy No. 9 (Fixed Guideway Transit, LRT)

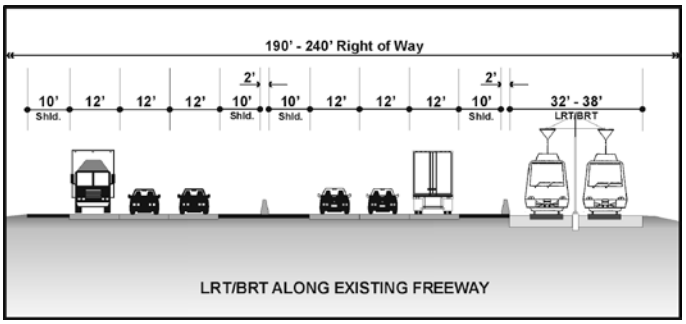
Description

This strategy would involve the construction of new fixed guideway transit improvements between KCI and Downtown, including the restructured transit center concept and expanded bus service contained in Strategy No. 2. Strategy No. 2 bus improvements would need to be refined to fully complement the fixed guideway system. This strategy would also include all facilities and services contained in the Base Condition Strategy. Candidate fixed guideway transit technologies include exclusive bus rapid transit (BRT), light rail transit (LRT) or commuter rail transit. Strategy No. 9 defines the LRT option.

3.9.2 Characteristics

Direct fixed guideway improvements would be provided between KCI and Downtown. The northern terminus would involve the construction of a new transit station connection at KCI. The southern terminal would entail a connection to existing or planned transit facilities in the downtown area, within the downtown freeway loop. Operational analyses will be developed with and without the completion of the Southtown Corridor LRT system south of Downtown. Intermediate on-line stations and associated park-and-ride lots would be provided as warranted. A new bridge crossing of the Missouri River would be provided due to the difficulties of widening the existing river bridges. Two fixed guideway alignments are described as follows:

- **I-29 Alignment –** Located along and within the I-29 right-of-way from KCI to the I-29/US 169 Interchange, then an alignment along US 169 through North Kansas City either along US 169 or along the north-south arterial street system. A new crossing of the Missouri River near the existing Heart of America Bridge crossing would be provided. A connection into the Downtown area would entail a terminal station within the downtown freeway loop, or a connection to the Southtown Corridor LRT system.
- **Kansas City Major Street Plan Alignment –** Located within the emerging development areas along Executive Hills North Boulevard and Line Creek Parkway. South of the I-29/US 169 Interchange, the alignment would be located along US 169 with an alignment through North Kansas City along either US 169 or the north-south arterial street system. A new bridge crossing in the vicinity of the Heart of America would be required. A connection into the Downtown area would entail a terminal station within the downtown freeway loop, or a connection to the Southtown Corridor LRT system.



Application:

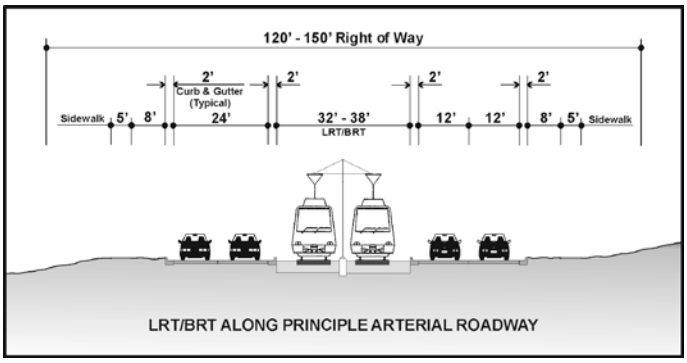
- I-29 Alignment along I-29.
- I-29 or Master Plan Alignment along US 169.

Features:

- Rapid transit corridor for either LRT or BRT.
- Two-way rapid transit operations.
- On-line stations would be provided at candidate crossroad interchange locations.

Costs:

- $17 to $35 Million/Mile



Application:

- I-29 or Master Plan Alignment along the arterial street system.

Features:

- Located within the middle or either side of roadway lanes.
- Two-way rapid transit operations.
- On-line stations would be provide at candidate locations, requiring additional width.

Costs:

- $13 to $28 Million/Mile

Issues

- Operational plan including service frequency and maintenance facilities.
- Bus service refinements to fully complement the fixed guideway system.
- Operational benefits with and without the implementation of the Southtown Corridor LRT system.
- Integration of fixed guideway improvements with the planned Johnson County Commuter Rail Pilot Project including the Union Station Intermodal Center.
- Considerations will need to be given to the financial implications of the ongoing operations and maintenance of this strategy.

3.10 Strategy No. 10 (Fixed Guideway Transit, Commuter Rail)

Description

This strategy would involve the construction of new fixed guideway transit improvements between KCI and Downtown, including the restructured transit center concept and expanded bus service contained in Strategy No. 2. Strategy No. 2 bus improvements would need to be refined to fully complement the fixed guideway system. This strategy would also include all facilities and services contained in the Base Condition Strategy. Candidate fixed guideway transit technologies include exclusive bus rapid transit (BRT), light rail transit (LRT) or commuter rail transit. Strategy No. 10 defines the commuter rail option.

Characteristics

Commuter rail service utilizing existing BNSF track from Downtown to Parkville, including the Hannibal Bridge. Parkville would be the northern terminus of the commuter rail service. The southern terminus would entail a connection with existing or planned transit service within the downtown area.

Issues

- Operational plan including service frequency and maintenance facilities.
- Bus service refinements to fully complement the fixed guideway system.
- Operational benefits with and without the implementation of the Southtown Corridor LRT system.
- Integration of fixed guideway improvements with the planned Johnson County Commuter Rail Pilot Project including the Union Station Intermodal Center.
- Considerations will need to be given to the financial implications of the ongoing operations and maintenance of this strategy.

3.11 Combination Strategies

The strategies described above all have unique benefits and costs associated with them. It is unlikely that a single strategy is the best for the entire Northland~Downtown Study Area. Consequently, combinations of the above strategies are recommended to maximize the benefit/cost ratio for the entire Study Area. Combination strategies proposed will be based on strategies that have a strong benefit/cost ratio individually and strategies that compliment one another.

NORTHLAND

DOWNTOWN

MAJOR INVESTMENT STUDY

Preferred Strategy Report
Index

HOV Assessment
Technical Memorandum

May, 2001

1.0 Introduction

This technical memorandum presents a summary of the High-Occupancy Vehicle (HOV) analysis. HOV lanes are exclusive use lanes for non-single occupant vehicles along a line haul and/or a queue bypass to avoid local congestion. HOV lanes were analyzed in the initial strategies phase of the study as well as the detailed analysis phase.

2.0 Initial Strategies Analysis

The Initial Strategies Definition Technical Memorandum provides a conceptual definition of High-Occupancy Vehicle Lanes (Strategy No. 7). In summary, HOV lanes are exclusive use lanes that were identified for either the US 169 or I-29/I-35 corridors during peak travel periods.

The HOV system would begin at a northern terminal in the vicinity of I-635 where congestion begins. The HOV system would extend all the way to downtown bypassing the most congested segments of the highway system terminating in the downtown with direct access into the CBD street system.

An HOV system serves commuters between high demand origins and destinations. Park and Ride lots located at strategic locations would attract motorists from the Northland to the HOV system. Express service penetrating the downtown area is the high demand center serving the HOV users. Encouraging motorists to carpool with improved and reliable travel times improves the person capacity of the corridor.

In the initial strategies phase, HOV lanes were analyzed and found to have mixed results for Northland motorists. The following is a summary of some of the points found in the Initial Strategies Evaluation Technical Memorandum. These findings are the results of HOV (Strategy No. 7) analysis as compared to the Base Condition (Strategy No. 1).

- HOV lanes would provide a reduction in regional vehicle miles traveled in 2020.
- HOV lanes would increase the total vehicle and person capacity across the Missouri River.
- A four to eight minute travel time savings could be achieved for HOV lane users of the KCI to CBD route and I-29/US 169 Interchange to CBD route.
- Between 700 and 2,700 daily home-based work trips could be attracted to the HOV system in 2020.
- There would be no change in the percent of roadway miles at LOS D or better.

- An HOV system was initially estimated to cost between $200 and $280 million dollars.
- The cost per daily hour of travel time saved in 2020 was no efficient.
- An HOV system would provide little benefit to improving the safety of travel in the Northland.

In the initial strategies phase, HOV lanes were determined to provide some benefits to the overall goals of the MIS, particularly the benefits in travel time savings. For this reason, HOV lanes were carried further to the more detailed analysis of the study.

3.0 Detailed Analysis

In the more detailed analysis phase, HOV lanes were combined with other strategies to develop alternatives. These alternatives are defined in the Initial Strategies Evaluation Technical Memorandum. As defined in the technical memorandum, HOV (Alternative D) also includes all the improvements in the Base Condition, Low Capital improvements, Travel Demand Management and Expanded Bus Service Strategies.

Due to physical constraints of adding more lanes along the US 169 corridor, an HOV system was determined to be developed in more detail along the I-29/I-35 corridor only. The system that was analyzed was from the I-635 Interchange area with direct access into downtown, Kansas City, Missouri along the I-29 corridor.

An HOV system along I-29/I-35 was analyzed using the MARC travel demand model, as described in the Transit and Highway Travel Demand Technical Memorandum. The results of the analysis indicate that between the I-29/I-35 split and the CBD, around 620 southbound A.M. peak hour vehicles could be expected to use the system. However, these vehicles are expected to experience a substantial travel time savings over the multi-use lane users.

MoDOT does not have any specific guidelines to the assessment of HOV systems. As a result, national guidelines related to the planning, design and operations of HOV systems were used in the detailed analysis phase. The following table provides a summary of the ability of an HOV system along I-29/I-35 to meet national guidelines. As shown in the table, there are a number of guidelines that could not be met for a successful HOV system.

4.0 Conclusions

The conclusions of the study team were not to recommend HOV Lanes (Alternative D) as part of the Preferred Strategy. There were a number of HOV guidelines that did not achieve the national guideline standard. An HOV system would capture existing ride sharers destined for downtown, plus any single-occupant vehicle conversion, but would not be supported with strong bus transit demand. In order to provide the reliability necessary to attract users, the HOV system would need to be a totally separated system providing direct access for motorists to avoid congestion and access the downtown street system directly. This type of separated system would be costly. In addition, agency and public support could not be measured at the time of this study.

HOV Lanes (Alternative D)
Fatal Flaw Assessment of I-29 HOV Improvements

Guideline Category	Typical Guideline	Northland (I-29) Corridor	Guideline Achieved
Congestion	• LOS E or worse. • Travel speed of 30 mph or less during peak period.	• I-29 operates at LOS E or LOS F in 2020. • Avg. travel speed of around 40 mph in peak period.	YES NO
Travel Time	• Reliable travel time savings. • One min. per mile savings. • Minimum savings of 5 min.	• 9.6 minutes of time saved from I-635 to Downtown (distance of 8.5 miles). • Reliability would need to be "built in".	YES
Minimum Vehicle Throughput	• 450 vehicles per hour. • 30 to 45 buses in peak hour.	• 620 vehicles/hour (+ SOV conversion). • 4 to 8 buses in peak hour.	YES NO
Person Throughput	• Equal or greater than adjacent mixed-use lanes.	• HOV person throughput of around 1,600 to 1,700 per hour. • Mixed use lane person throughput of around 2,200 to 2,700 per hour.	NO
Capacity Improvement	• Included as capacity improvement (not replacing or borrowing).	• HOV lanes would be added to existing transportation system.	YES
Local Agency and Public Support	• Supported by local, regional and state agencies. • Part of program of regional TDM improvements.	• Agency support is undetermined. • Public support is undetermined.	UKNOWN
Enforceability	• Must be effectively enforced.	• MoDOT has no legal HOV enforcement authority. • Enforcement would have to be provided. • Additional operational costs would be incurred.	NO
Cost Effectiveness	• Benefits should exceed construction and operational costs.	• Cost effectiveness has not be estimated.	UKNOWN
Physical Characteristics of the Roadway	• Meet standard roadway and roadside design criteria.	• Roadway and roadside design standards would be met.	UKNOWN

Source: High-Occupancy Vehicle Facilities – A Planning, Design, and Operation Manual Parsons Brinckerhoff Quade & Douglas, Inc., 1990

Fixed Guideway Transit Route Studies Technical Memorandum

January, 2001

1.0 Introduction

The Northland~Downtown MIS has included the development and analysis of a fixed guideway transit system for the corridor between Downtown Kansas City and Kansas City International Airport (KCI). At this level of planning, the fixed guideway transit technology has not been chosen. Light rail transit and bus rapid transit were considered to be the most likely potential technologies. For the purposes of comparing alternative alignments and potential station locations, the MIS assumed the use of light rail transit (LRT) technology for the Fixed Guideway Transit strategy. Comparisons between LRT and BRT could be the subject of future analyses. A commuter rail alternative was also considered early in the study, but was dismissed due to low ridership and high cost.

The MIS considered potential fixed guideway transit alignments for three parts of the corridor at various stages within the study: (1) the I-29/US-169 Interchange to KCI, (2) Downtown Kansas City to the I-29/US-169 Interchange, and (3) North Oak Trafficway to Waukomis. The analysis of fixed guideway transit alignments from the I-29/US I69 Interchange to KCI was performed in the conceptual strategies phase of the MIS. The subsequent, more detailed alignment study focused on alignment issues between downtown and the I-29/US I69 Interchange as the initial first stage of fixed guideway transit implementation.

2.0 Alignment from the I-29/US 169 Split to KCI

An analysis of fixed guideway alignment options north of the I-29/US-169 Interchange (the "Split") was performed during the early conceptual strategy phase of the MIS. At this early point in the study, the Steering and Advisory Committees were considering three potential fixed guideway options:

- Downtown to KCI following Kansas City, Missouri's Master Plan Alignment (Waukomis and Line Creek) north of the I-29/US-169 Split,
- Downtown to KCI following I-29 north of the I-29/US-169 Split, and
- Downtown to the I-29/US-169 Split only.

To compare the two alignment options north of the I-29/US-169 Split, the study team performed a qualitative analysis to identify each option's advantages and disadvantages (Table 1). The Steering and Advisory Committees considered these results and concluded that the economic development potential of fixed guideway transit was greater in the Line Creek alignment, and that further study of multiple alignment options would not be necessary to reach the needed outcomes of this study. This would not preclude the consideration of an I-29 alignment at some

future date, in another study.

The Steering and Advisory Committees also agreed with the Study Management Team recommendation to limit the more detailed analysis of fixed guideway transit to that portion of the corridor that lies south of the Split. This decision recognized that study resources were limited and that potential ridership might not justify fixed guideway transit north of the Split within the 20-year horizon of the study. However, the Committees requested that a sensitivity analysis be done using the regional travel demand model to assess the ridership benefits of extending fixed guideway transit to KCI. This analysis was later done assuming the Kansas City, Missouri Master Plan Alignment.

3.0 Downtown to the I-29/US-169 Split

3.1 Alignment Options between North Kansas City Line and I-29

In the move detailed phase of the MIS, the Study Team evaluated three fixed guideway transit alignment options for the segment of the corridor between the northern boundary of North Kansas City (32nd Avenue) and an interim terminus in the vicinity of the I-29/US-169 Split. The three options, initially suggested by the City of Kansas City, were:

- Option B-1 (KC,MO Master Plan Alignment): North side of Waterworks Park and the Water Plant to Route 169, then north along the west side of Route 169 to the I-29 Interchange, then west along the southern side of the I-29 right-of-way to Waukomis.

- Option B-2: North Oak Trafficway to Vivion Road, west on Vivion Road to the US169/I-29 Interchange. From there, option B-2(A) would enter I-29 right-of-way and follow north side of I-29 to Waukomis. Option B-2(B) would follow Vivion Road through the I-29/US169 Interchange, then turn north along the west side of US169 and follow the Master Plan alignment to Waukomis.

- Option B-3: North side of Waterworks Park and the water plant to Northwest Platte Road, then following along NW Platte Road to Riverside and Vivion Road to Waukomis.

The analysis considered such factors as capital cost, ease of design and construction, land use, service, and ridership. The advantages and disadvantages of each option are presented in Table 2.

At its April 27, 2000 meeting, the ~~and the~~ Steering Committee and the Advisory Committee reviewed the preliminary analysis of three fixed guideway alignment options between Downtown Kansas City and the I-29/U.S. 169 Split. The Committees agreed that, to simplify the analysis, the study team would focus on a portion of Alignment Option B-2 for the remainder of the MIS. The fixed guideway would follow North Oak Trafficway from the Waterworks to an interim terminus in the vicinity of I-29. It was recognized that other alignments could be given further consideration in future project development studies, such as the National Environmental Policy Act process.

Table 1
Pros and Cons of LRT Alignment Options
North of the I-29/US 169 Split

Alignment Options	Capital Cost (a) (million 1999 $)	Evaluation Factors	Pros	Cons
Master Plan Alignment following Waukomis and Line Creek	Longer line but fewer structures than I-29 alignment	Design and Construction	Alignment is largely open, simplifying construction.	
		Land Use	Greater opportunity to create transit-friendly nodes of development around LRT stations, consistent with FOCUS.	Significant development has not yet taken place and is more speculative.
		Service and Patronage	LRT stations could be integrated into surrounding development, increasing pedestrian access	LRT would operate in mixed traffic and have at-grade crossings, reducing speed.
		Other		
I-29 R-O-W from the Split to KCI	Shorter line but more structures than Master Plan Alignment	Design and Construction		Construction would be more complicated -- structures, potential conflicts with existing development and roadways.
		Land Use	Has higher amount of existing development.	Existing development is auto-oriented.
		Service and Patronage	LRT would operate with be on reserved R-O-W and could operate at higher speed. A LRT trip from KCI to downtown would be 10 to 15 minutes faster. Better access for residents west of I-29.	
		Other		Stations and Park/Ride lots would add auto and bus traffic to congested areas near I-29 Interchanges.

(a) Cost from I-29/US 169 Interchange to KCI.

Table 2
Pros and Cons of Alignment Options
Between North Kansas City Line and the I-29/US 169 Split

Alignment Options	Capital Cost (a) (million 1999 $)	Evaluation Factors	Pros	Cons
Option B1 (Adopted Alignment): North side of Waterworks Park and water plant to Route 169, then north along the west side of Route 169 to I-29 Interchange, and west in I-29 R-O-W to Waukomis (3.4 mi.)	BRT: $120-$160 LRT: $220-$300	Design and Construction	• Traffic and other impacts of construction would be lowest	
		Land Use		• Does not serve existing concentrations of population or employment. • Fewest opportunities for redevelopment. • Lowest potential for walk-on riders.
		Service and Patronage	• Shortest and fastest option. Travel time from Waukomis to No. KC line would be approximately 9 min (b)	
		Other	• Fewest local traffic impacts	

Table 2 (Continued)
Pros and Cons of Alignment Options
Between North Kansas City Line and the I-29/US 169 Split

Alignment Options	Capital Cost (a) (million 1999 $)	Evaluation Factors	Pros	Cons
Option B2: North Oak Trafficway to Vivion Road, west on Vivion Rd. to US169/I-29 Interchange. Option B2a would enter I-29 right-of-way and follow north side of I-29 to Waukomis (3.8 mi.). Option B2b would follow Vivion Rd. thru the Interchange, then turn north along west side of US169 and follow adopted alignment to Waukomis (3.9 mi.).	BRT: NA LRT: NA	Design and Construction		• Requires reconstruction of N. Oak Trafficway and Vivion Road to create a transit envelope. • For LRT, grades may be problematic. • B2a would require a major structure in the I-29/US169 Interchange.
		Land Use	• Serves mixed use development at N. Oak Trafficway and Vivion Road. May foster new development/ redevelopment. • Serves moderate density neighborhoods near N. Oak Trafficway south of I-29. • Highest potential for walk-on riders.	
		Service and Patronage	• Station and park/ride lot at Vivion Road would provide direct access for residents of Gladstone (both bus and park/ride). Good bus/rail transfer opportunity.	• May be difficult to find a suitable site for park-and-ride lot and bus transfer center near N. Oak and Vivion Road. • Longer and slower than B1. Travel time from Waukomis to North KC Line is nearly 5 min. longer (b).
		Other		• Would require taking of lanes and/or private R-O-W along N. Oak Trafficway and Vivion Rd. • Would impact traffic at N. Oak Trfwy and Vivion Rd. intersection.

Table 2 (Continued)
Pros and Cons of Alignment Options
Between North Kansas City Line and the I-29/US 169 Split

Alignment Options	Capital Cost (a) (million 1999 $)	Evaluation Factors	Pros	Cons
Option B3: North side of Waterworks Park and water plant to NW Platte Road, along NW Platte Road to Riverside, then along Vivion Road to Waukomis (4.0 mi.)	BRT: NA LRT: NA	Design and Construction	▪ Grades may be less problematic than with option B2.	• Requires reconstruction of NW Platte Road in Riverside to create a transit envelope.
		Land Use	• Serves pocket of lower income residents north of Riverside • Could encourage redevelopment in Riverside.	
		Service and Patronage		• Longer and slower than B1. Travel time from Waukomis to No. KC Line would be at least 5 minutes longer (b). • Out-of-direction travel may discourage ridership.
		Other		• Would require taking of lanes or private ROW along arterials. • Traffic impacts in Riverside.

(a) Cost estimates are for segment from downtown to I-29/Waukomis, and include new bridge across the Missouri River.
(b) Travel time calculations assume 23 mph average speed for freeway/reserved ROW portions of the route and 15 mph average speed where transit vehicles operate in arterials and are subject to traffic signals and other delays. These assumptions are derived from FTA's Characteristics of Urban Transportation Systems, 1992.

3.2 Description of the First Stage MIS Alignment

The following section describes the assumed fixed guideway transit alignment for consideration by the MIS. For the purposes of determining the performance benefits and associated costs of fixed guideway transit investments LRT technology was assumed. The technology to be utilized and the guideways alignment would be subject to subsequent and more detailed study.

The fixed guideway transit alignment begins near the intersection of 3rd and Grand in the City Market area of Downtown Kansas City with a connection to the planned Central Business Corridor LRT line. The alignment continues north along Grand then curves to the east onto 2nd Street. The alignment passes under the Heart of America Bridge (HOA) then curves to the north and aligns itself immediately adjacent to and east of the HOA as it crosses Missouri River.

The line touches down in North Kansas City immediately north of the existing rail yard and east of the approach to the HOA Bridge and then stops at a passenger station at 10th Street and Burlington Avenue. The station has an island or center platform located in the existing "green space" south of 10th Street. The line leaves the station area and crosses 10th Street using the existing traffic signal and finds the median of Burlington Avenue. The roadway pavement of Burlington would be reconstructed with the fixed guideway transit facility occupying the median section of the roadway. Two through roadway lanes will be provided in each direction along Burlington and the existing left-turn lanes will be retained. The transit section is separated from the traffic lanes by landscaped planting areas located on both sides of the alignment.

The lines continue northward along the median of Burlington Avenue. The next passenger station is located at 18th Street. The station area consists of two side platforms. Separate platforms, one for northbound and one for southbound trains are each located just beyond the street intersection relative to the direction of travel. With this station platform configuration, the guideway would pass through the roadway intersection and then stop at the passenger station. The operations of the guideway along Burlington and through the existing intersections will be controlled by the traffic signals.

After leaving the station, the line continues northward towards the North Oak Trafficway and Missouri Route 9 split. The line veers to the right following the through lanes to North Oak Trafficway. A passenger station is located in the existing median area of North Oak Trafficway north of the intersection. The guideway remains in the median or center portion of North Oak Trafficway as it continues northeasterly through the 32nd Street traffic signal and then up the hill. The line continues north following the undulating roadway profile of North Oak Trafficway. The roadway grades vary considerably from moderate (2% to 4%) to very steep (6% and greater). Modern light rail vehicles (LRVs) are able to negotiate these grades, but travel speeds may vary in the sections of the steep grades.

The next passenger station is located near the 42nd/Briarcliff intersection. This station would have a split-platform configuration similar to the 18th & Burlington station. Transit operations through the intersection would be controlled by the traffic signals. The line continues north and terminates at a passenger station located approximately 500 feet south of the I-29/North Oak Trafficway Interchange. The terminal station is positioned in the median of North Oak Trafficway. The existing North Oak Trafficway roadway profile in the station areas is considered to be too steep of grade for an at-grade LRT passenger station. However, the new profile of the LRT alignment can remain "level" through the station area by constructing retaining walls to "hold-up" the LRT trackway and station as the roadway continues on its downward grade under I-29 further to the north.

Conceptual plans for the fixed guideway transit are located in Appendix A. The overall length of the guideway from the City Market area in Kansas City to the I-29 Station in the Northland is approximately 5.16 miles.

3.3 Stations

Three stations are planned for the North Oak Trafficway segment:

- **29th & Burlington Avenue.** This station is located in the far southern portion of the North Oak Trafficway segment. The station has a center platform positioned in the existing median space between the northbound and southbound lanes of North Oak Trafficway located just north of the intersection of Burlington Avenue and Missouri Route 9. A large park-and-ride facility could be constructed on the site of the apartment buildings immediately to the east. Access to the station platform could be via a new pedestrian walkway bridge over the "free-flow" right through lanes from northbound Burlington Avenue onto North Oak Trafficway. An option could be to add a traffic signal to stop the "free-flow" movement from Burlington to North Oak Trafficway and allow pedestrians to cross the roadway lanes at-grade to then access the station platform.

- **42nd & North Oak Trafficway.** The station area consists of two split-side platforms. The separate side platforms, one for northbound and southbound trains are located just beyond the intersection respectively. Transit operations along North Oak Trafficway and through this intersection would be controlled by the traffic signal. With each station platform located just beyond the intersection (in the direction of travel), transit vehicles will be able to pass through and clear the intersection and then stop at the passenger station and minimize delays to both transit and local traffic.

- **I-29 & North Oak Trafficway.** The station platform is envisioned to be a center platform located in the median of North Oak Trafficway. Immediately east of the line would be a large park-and-ride facility. This would be a "joint-use" facility sharing the parking lot with the existing church. Provisions for bus interface would also be provided. Access to the platform would be via a new pedestrian bridge over both sides of North Oak Trafficway and the "on-ramp" traffic to I-29. The station platform would appear to be at-grade at its southern end and above the North Oak Trafficway roadway grade at the north end. Retaining walls would be used to "hold-up" the alignment and the north end of station.

All station platforms would have the usual station amenities for the transit riders such as station canopies, seating, windscreens, fare vending equipment, passenger assist telephones. Park-and-ride lots would include paved surfaces for parking, bus drop-off, access sidewalks to the platform areas, parking lot and sidewalk lighting, system information kiosks, ticket vending areas, landscaping, public and emergency telephones.

3.4 Typical Sections for LRT

The typical section varies at different locations along the alignment. In the areas of exclusive LRT operations such as 2nd Street in Kansas City and in the median section of Burlington between the existing street intersections, the typical section would consist of the standard rails on ties and ballast. Paved track sections will be provided at locations where automobile and truck traffic cross the LRT alignment, such as at street intersections and along portions of North

Oak Trafficway. In paved track, the rails of the trackway are constructed "flush" with the roadway pavement so vehicles can readily drive over the rails. In the segment along North Oak Trafficway, raised curbs would be constructed on each side of the LRT. The raised curbs will serve to delineate the LRT trackway from the normal driving lanes and to preclude vehicles from turning left into the path of an approaching LRV from either direction. Crossing of the trackway should be limited to the designated traffic signal controlled intersections.

The introduction of the LRT on North Oak Trafficway would require the reconstruction of the roadway. The LRT typical section requires approximately 30 feet of width. The preferred approach is to construct the trackway in the median of the roadway and reconstruct the driving lanes immediately adjacent to the trackway. The existing right of way is generally wide enough to allow for the added width of the trackway. Additional property may be required at the station areas.

3.5 LRT Profile and Grades

Light rail vehicles have the ability to operate on streets with a rather wide range of profile grades. The typical maximum grade for the average light rail vehicle is between 5 and 7 percent. The maximum grade allowed in the KCATA design criteria is 7 percent. The St. Louis MetroLink system has established maximum allowable grades between 3 to 4 percent. The ultimate selection of allowable maximum grades is generally the choice of the operating entity and as required by other local site-specific conditions.

The roadway profile along Burlington is generally less than one percent. On the other hand, the profile of North Oak Trafficway is rather steep, with grades exceeding 6 percent along certain segments of the road. An LRV can safely and effectively operate on grades up to 6 percent. However, the sections where the grades exceed 4 percent will require special maintenance and attention especially during icy and inclement weather conditions. The grades through the stations should be held to a maximum of 1 to 2 percent.

3.6 LRT Median Running

The LRT trackway is assumed to operate in the median of North Oak Trafficway as opposed to running along one or both sides of the roadway. The following is a listing of the pros and cons for the median running configuration.

Pros

- Simplifies the signal and train control of the trains at roadway intersections.
- Allows train operations to be controlled by traffic signals. Side running requires need for standard railroad cross gates at intersections and driveways due vehicles turning to the right.
- Avoids the crossing of curb cuts and entrances to numerous businesses and homes along each side of North Oak Trafficway.
- Provides continuity with the median running segment along Burlington Avenue.
- LRVs travel in the same direction as the adjacent vehicular traffic. Side running requires contra-flow operations to a certain extent.
- Simplifies roadway drainage collection
- Expedites expansion of the LRT alignment further to the north past I-29

Cons

- Requires reconstruction of both sides of the roadway.
- Requires relocation of utilities on both sides of the roadway.
- Requires a barrier between trackway and the normal roadway lanes for separation between the two.
- Reduces the locations for allowable left-turns along North Oak Trafficway.

Traffic control of the trains, while in the median sections, can be by cab signals, line-of-sight by the LRV operators, and the roadway traffic signal system. The trains will travel the same direction as the adjacent roadway vehicles. Left turns across the LRT trackway would not be allowed except at designated intersections where left-turn lanes would be provided. A new traffic light and dedicated left-turn lanes could be installed at the intersection of the entrance to Water Works Park and the Farmland Industries facility. The new traffic signal would allow vehicles to safely turn left either east or west across the tracks to access these large existing facilities. In addition, two new loop roads or turnarounds with traffic signals could also be constructed to allow the controlled crossing of the vehicles over the LRT alignment. The first turnaround could be located on the east side of North Oak Trafficway near Indiana between 32nd and 42nd Streets. The second turnaround could be located between 42nd Street and the I-29 Interchange, possibly near 44th Street.

3.7 Impacts Summary

The following is a summary list of the general impacts associated with the construction and operation of the LRT along North Oak Trafficway:

- Requires the widening of both sides of the roadway including all intersections and driveways.

- To reduce right-of-way acquisition requirements, the new roadway could include curb and gutter sections requiring enclosed underground roadway drainage. (The existing road uses a system with paved ditches.)

- The installation of the LRT trackway and curb barriers in the median limits the locations for allowable left-turns along North Oak Trafficway.

- LRT operating times will be longer due to the slower LRT operating speeds because of the steep grades along North Oak Trafficway.

- Additional right-of-way will be required in the vicinity of the 42nd St. & North Oak Trafficway to make room for the station platforms.

- Retaining walls will be required along certain portions of the alignment in order to reduce right-of-way acquisition.

4.0 Connection from North Oak Trafficway to Waukomis

On August 24, 2000, the Study Team presented its more detailed conceptual engineering plans for Alignment B-2 to the Steering and Advisory Committees. ~~As presented, the interim terminus for fixed guideway transit would be immediately south of the North Oak/I-29 interchange.~~ The Committees asked the Study Team to assess the feasibility of a fixed guideway ~~investigate the~~alignment ~~options~~ between the North Oak Trafficway/I-29 Interchange and Waukomis. It wanted to be assured that the North Oak Trafficway alignment would not preclude a future connection to Waukomis and the Master Plan alignment along Line Creek (i.e., Stage 2).

Two potentially feasible alignments were identified for the segment between the North Oak Trafficway/I-29 Interchange and the Waukomis/I-29 Interchange (see Figure 1):

- **Alignment 1 (south)** begins in the median of North Oak Trafficway south of the I-29 Interchange. Heading northward, the line immediately curves to the west and bridges over southbound North Oak Trafficway, the future reconfigured I-29 off-ramp, and the I-29 mainline. A station with a park-and-ride lot would be located immediately west of the I-29 crossing. The fixed guideway alignment would then cross Vivion Road at grade and follow Vivion Road (adjacent to the northern edge of the roadway) in a westerly direction, passing under the I-29 bridges and the US 169 bridges using the space available in the far north span. A station with a park-and-ride lot could be located north of Vivion Road immediately west of US 169. The alignment would then follow along the south side of I-29, cross over I-29, and follow along the north side to Waukomis. A third station and park-and-ride lot would be located northwest of the interchange at Waukomis and I-29.

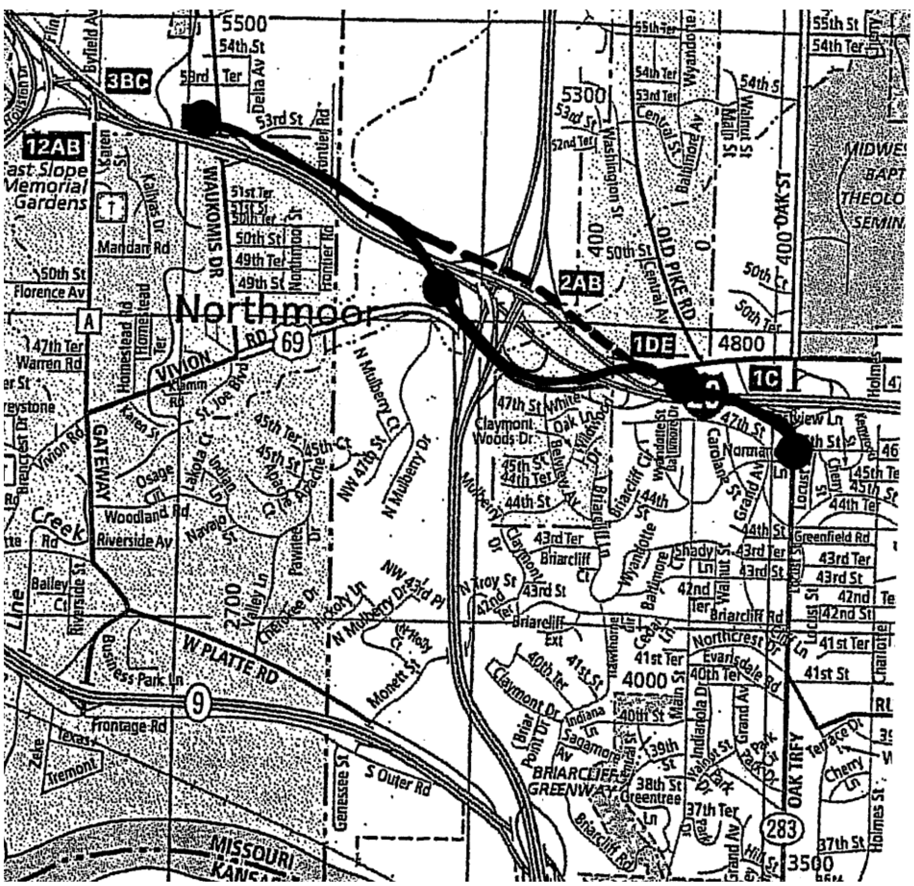
- **Alignment 2 (north)** begins in the median of North Oak Trafficway south of the I-29 Interchange. Like alignment 1, it immediately turns west and bridges over southbound North Oak Trafficway, the I-29 off-ramp, and the I-29 mainline to reach a station and a park-and-ride lot north of I-29 and south of Vivion Road. This alignment would then bridge over Vivion Road and follow along the north side of westbound I-29 to a station and park-and-ride lot northwest of the Waukomis/I-29 Interchange.

The following table provides a comparison of the two alignments:

Table 3
Alignment Comparison

	Alignment 1 (South)	Alignment 2 (North)
Length (miles)	2.14	2.05
Number of Stations	3	2
Capital Cost (million 2000$)	$94.1	$97.8

Figure 1
Alignment Options
from North Oak Trafficway/I-29 Interchange to Waukomis/I-29 Interchange



Notes:
1. Alignment 1 (South) is shown with a solid line.
2. Alignment 2 (North) is shown with the dashed line where it deviates from Alignment 1.
3. Proposed Station locations are shown with solid circles.

NORTHLAND

DOWNTOWN

MAJOR INVESTMENT STUDY

Conceptual Alternative Alignments from North Oak

Downtown Land Use and Freeway Loop Technical Memorandum

September, 2001

1.0 Introduction

The implications for expansion of existing bridges across the Missouri River needed to be evaluated further. This evaluation would help clarify how the various alternatives could be combined within a preferred strategy for the Northland~Downtown Major Investment Study. Additional analysis included an assessment of the impacts on the Kansas City metropolitan area's Central Business District (CBD) and its surrounding freeway loop. This analysis was performed to ensure that traffic flow to, from and around the central business district would not be negatively impacted. The CBD and downtown are defined as the area within and around the circumferential freeway loop. Loop is defined as the freeway that encircles Downtown Kansas City, Missouri.

Concerns were also raised by Steering and Advisory committee members about the land use and development implications of additional freeway capacity leading into the CBD loop. Concerns included the operational viability and effectiveness of the proposed bridge and roadway improvements on the CBD circumferential freeway loop and … as a result, the downtown analysis addressed these concerns.

The analysis was organized into two interrelated areas of focus:

- **Land Use Analysis** – Aimed at identifying the land use impacts and development analysis that may affect or be affected by the transportation system changes.

- **Traffic Operations Analysis** – Aimed at conceptually addressing the transportation impacts of proposed changes to the downtown loop and access system. These changes include both planned and potential modifications to the downtown loop and associated access roadways.

1.1 Goals of Loop Study

The following goals were established for the loop study:

- **Loop Operations** - Identify implications of adding four lanes to the Paseo Bridge crossing of the Missouri River on the traffic operations of the existing Downtown freeway loop. This translates to two additional lanes leading into the downtown loop and two additional lanes leaving the downtown loop.

- **Land Use and Development Goals** – Assess various loop modification scenarios, with or without the Paseo Bridge widening, regarding the ability to complement and

fulfill the City's land use and development goals for the downtown area as defined in FOCUS.

- **Northland~Downtown MIS Decision** - Factor traffic operations and land use implications of a Paseo Bridge widening on the downtown loop as part of the Northland~Downtown MIS decision-making process for the best transportation improvement strategy.

1.2 Purpose of Downtown Loop Improvements

The goals of the downtown loop transportation system improvements are to provide a safe, efficient and cost-effective transportation system that:

- Promotes downtown as "destination" for travel,
- Provides efficient access in and out of downtown,
- Provides safe and modern transportation facilities,
- Complements major street plan and traffic circulation patterns within and around the loop,
- Supports land use and development goals of FOCUS for downtown and central business district, and
- Complements the Central Business Corridor Community Plan.

1.3 Loop Issues

The following loop issues were established for the study:

- Major Travel Patterns - What are the major travel patterns into and through the loop?
- Freeway System Continuity – What are the generalized system continuity requirements for the loop?
- Access and Street Circulation – What are the major access points into downtown and what are their relationships to the major street circulation in downtown?
- Loop Operations and Deficiencies – In general, what are the existing and projected deficiencies of the loop?
- Physical Limitations – What are the generalized physical constraints affecting the ability to improve the loop?
- Land Use and Development – What is the relationship of the current and future transportation system in downtown (roadway, transit and pedestrian) with downtown land use and development opportunities?
- Case Studies – What have other communities done to their downtown freeway system to promote land use and development goals?

1.4 Baseline Loop Configuration Scenarios:

The following scenarios were identified for assessment. Figure 1 provides a schematic of each scenario.

- **“No-Build” Base Scenario**

  This scenario represents the “do nothing” condition including the existing loop and street system with the CBC Community Plan, completion of Bruce R. Watkins Drive, and completion of the 5th/6th Street improvements. This scenario provides a basis of comparison for the assessment of the other scenarios. This scenario represents the No-Build, Alternative A for the MIS, as described in the Initial Strategies Evaluation Technical Memorandum.

- **Modified Base Scenario**

  This scenario includes the existing loop configuration with the four-lane widening of the Paseo Bridge. This scenario represents the Partial Roadway with 1st Stage Fixed Guideway, Alternative F for the MIS, as described in the Initial Strategies Evaluation Technical Memorandum. This scenario would include all other improvements included in the “No-Build” Base Scenario, including most notably the CBC Community Plan.

1.5 Loop Design Concepts:

Loop design concepts were identified to address existing and future loop problems related to traffic operations and land use in and around the central business district. These loop design concepts represent significant reconfiguration of the existing loop.

- **Design Concept No. 1 – Partial One-Way Loop**

  This concept includes the conversion of the west and east legs of the loop to one-way freeway operations. Other features may include the construction of decks over the north and/or south legs of the loop.

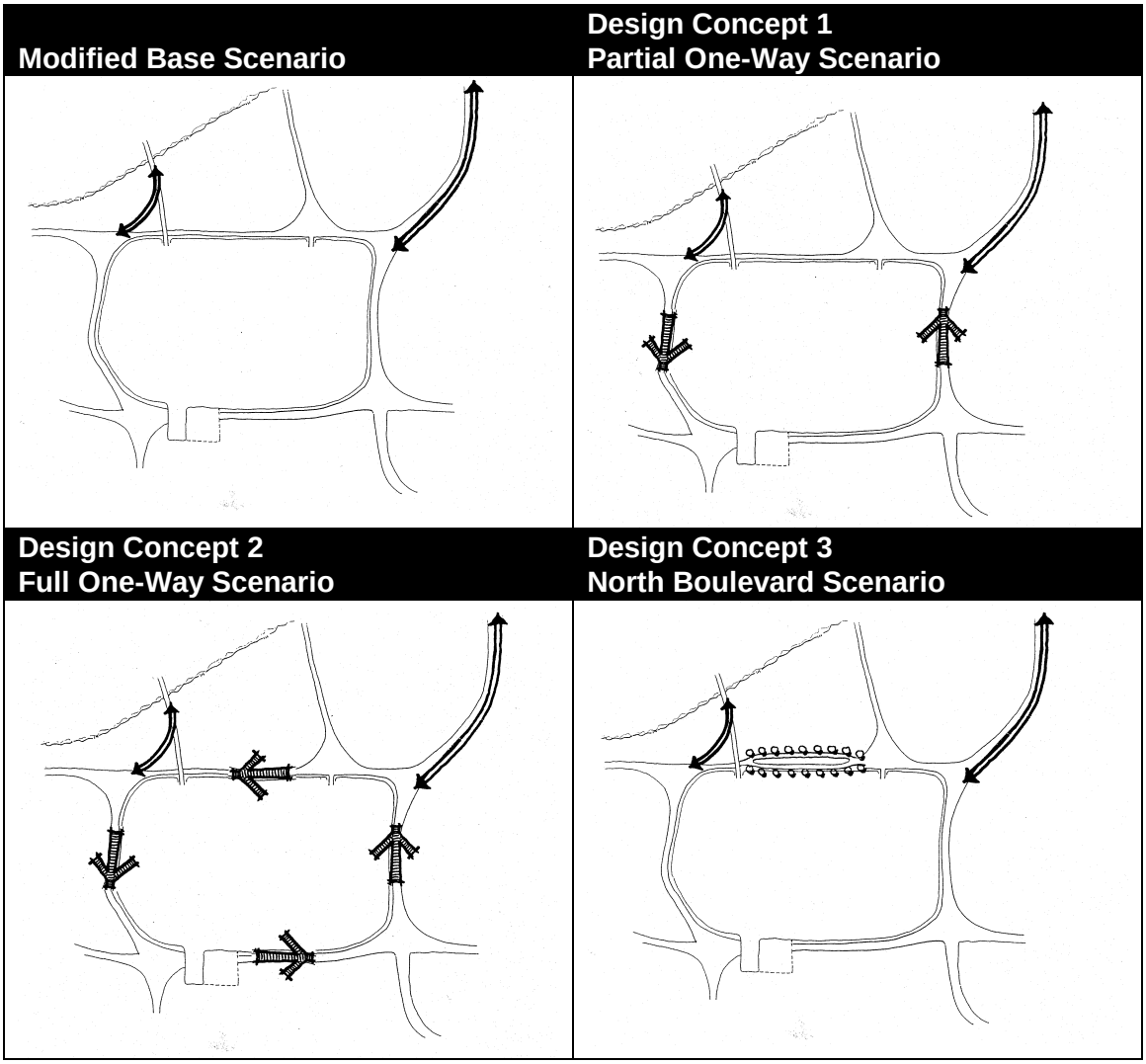
- **Design Concept No. 2 – Full One-Way Loop**

  This concept includes the full conversion of the loop to one-way freeway operations. Other features may include the construction of decks over the north and/or south legs of the loop.

- **Design Concept No. 3 – North Boulevard Scenario**

  This concept includes the conversion of the north leg of the loop to an arterial parkway with at-grade intersections and/or a potential modern roundabout. Other features may include the construction of decks over the north and/or south legs of the loop.

Figure 1
Downtown Loop Reconfiguration Concepts



2.0 Land Use Analysis

The purpose of the Land Use Analysis is to ensure that transportation changes are consistent with and are supportive of existing Downtown plans and policies. This analysis is based on information from the Urban Core Plan (FOCUS), the Citywide Physical Framework (FOCUS) and the Downtown Development Strategy (SASAKI).

2.1 Land Use Goals

The following land use goals were used to evaluate the potential land use impacts of the loop design alternatives. These goals were identified from the *FOCUS Kansas City Plan*, adopted by the City in 1998 and supported by extensive input and public participation. The *Urban Core Plan,* a component of FOCUS, reinforces the key concept that the urban core, i.e. downtown, is

the primary activity center of the metropolitan area. Access to and from the Downtown Loop is critical to support anchors such as the convention center, the civic center, and the proposed performing arts center – all of which add value to the surrounding area and are catalysts for new development.

1. Support the major activity centers that exist in and around the downtown loop. Access to these centers is essential to their viability and success. The following centers were identified:
    - Bartle Hall, its anticipated expansion and the convention complex
    - The planned Performing Arts Center
    - The mixed-use revitalization efforts currently underway in the Crossroads/Freighthouse District, the area east of the Civic Mall, in the River Market and on the west side in Quality Hill and the Garment District.
    - The anticipated large redevelopment area in the area south of 13th Street and west of the Power and Light Building within the CBD loop.
    - The planned riverfront redevelopment adjacent to Richard Berkeley Park and Front Street.
2. Connect the major activity centers that exist in and around the downtown loop, including the CBD to the River Market and to the Crossroads/ Freighthouse District.
3. Support Downtown as a destination and employment center. (This study coordinates with the Civic Council's Downtown Development Strategy.)
4. Support additional residential development/redevelopment opportunities in and around the CBD.

2.2 Summary from Existing Plans

Each of the three plans described above - *FOCUS Kansas City Urban Core Plan*, *FOCUS Kansas City Physical Framework*, and *Downtown Development Strategy (Sasaki Plan)* – make recommendations about the Downtown environs. These recommendations include:

FOCUS KANSAS CITY URBAN CORE PLAN

- Invest in Great Streets in the CBD (Grand Ave. is a primary Great Street).
- Concentrate investment in new urban amenities.
- Develop Riverfront with new mixed-use development.
- Continue to support and enhance the River Market.
- Encourage new business development in Paseo West ("superior highway access of the area is [a] significant advantage").
- Encourage infill and rehabilitation residential development in Parkview/Downtown East.
- Support efforts to rehabilitate underutilized buildings, remove dangerous buildings, accumulate sufficient property for proposed projects, and implement projects that will create new jobs and places for people to live.
- Augment existing residential alternatives and create a new residential district in the northeast corner of downtown.
- Continue to support and enhance the River Market.
- Create commercial bridges to the River Market on Walnut Street.

FOCUS Kansas City Physical Framework

- Providing basic services to the Northland.
- Completing the arterial street and boulevard system and construct new improvements that serve the priority development areas.
- Increasing the effective capacity of the existing circulation system.
- Creating an integrated, multi-modal transportation system that is accessible and useful for all residents and visitors.
- Supporting compact and mixed-use patterns of development that reduce long commutes, retain open spaces, and maximize costs for public services and facilities, particularly along transit corridors.

Downtown Development Strategy (Sasaki Plan)

- Reconstructing I-70 (north leg of loop) into a boulevard to reintroduce Kansas City's boulevard system into the Downtown.
- Providing a more pedestrian friendly and green space setting for new development.
- Creating of a new destination park within the corridor, bridging the Downtown and River Market.
- Establishing the East Loop area (8th to 11th, Cherry to Charlotte) as a residential neighborhood to complement Quality Hill.

Each of these recommendations was read in conjunction with the project land use goals and applied to the geographically relevant part of the Downtown Loop for the purposes of this analysis.

2.3 Land Use Options

Each of the Loop configuration scenarios and design concepts (described in Sections 1.4 and 1.5) were reviewed with respect to their potential impact on existing land uses, as well as their potential to support future land use goals outlined in the existing planning documents referenced above.

No-Build Base Scenario

This scenario assumes no significant changes to the existing system and configuration.

Land Use Issues:

- East and South segments of the Loop are not sized adequately to handle existing traffic demands, and may limit development opportunities and interest along these areas.

- Impacts on the existing land uses adjacent to these segments of the Loop may be high due to additional freeway lanes and width requirements.

- U.S. 169 connection to the Loop is constrained and causes frequent traffic delays. The Broadway corridor has significantly redeveloped and has limited infill sites.

- Paseo Bridge is nearing capacity. Traffic growth on this bridge continues to outpace growth on other bridges into Downtown. Opportunities to access downtown may not allow users convenient access to their intended destination.

- With the exception of the recently completed BRW corridor, the existing visual appearance and urban design of the freeway system leading into Downtown and throughout the Loop does not reflect the surrounding character of the area. This creates a negative impact on adjacent land use and redevelopment initiatives.

Modified Base Scenario

This scenario assumes a four-lane widening of the Paseo Bridge, new ramps connecting U.S. 169 to the Loop, and other improvements described in Alternative F (Partial Roadway with 1st Stage Fixed Guideway).

Land Use Issues:

- Additional lanes are necessary on the East and South Loop segments to handle existing traffic and anticipated future traffic demands. These additional lanes may improve the flow of traffic through the Loop, but could create difficulties in accessing CBD exits along these segments of the Loop.

- Major North-South traffic movement on the East segment of the Loop is anticipated connecting I-29 and U.S. 71 (BRW).

- Impacts on the existing land uses adjacent to these segments of the Loop may be high due to additional freeway lanes and width requirements.

- CBD access from the East Loop would be relocated to utilize the proposed one-way pairs of Charlotte and Harrison. This would allow greater access to development opportunities east of the Civic Mall and in the Paseo West area. A new direct CBD access is identified for the northeast quadrant of Downtown at Charlotte from I-35 South.

- Land acquisition and construction of the ramps connecting U.S. 169 to the Northeast corner of the Loop will create a significant negative impact to existing land uses in the immediate vicinity. Recent City initiatives to enhance the Broadway Corridor create a precedent for high quality urban planning and aesthetic treatments to be incorporated in the design of these improvements to support future redevelopment of the area.

- South Loop CBD area may need access reconfiguration due to additional lane needs - potential to eliminate Wyandotte access from I-670 Eastbound under an expanded Bartle Hall. (This would occur under all scenarios analyzed.) The location of major existing and proposed CBD destinations adjacent to the South segment of the loop indicates a strong need for direct and convenient access to the freeway system.

- Improved land use and urban design connectivity between the Downtown, Crossroads and the Riverfront areas could be accomplished by decking over I-670 (south side of loop) and I-70 (north side of loop) with open space and/or commercial development above.

- Impacts on the existing freeway system operations during construction may be lower than other alternatives.

Design Concept No. 1 – Partial One-Way Loop

This concept includes the conversion of the West and East segments of the Loop to one-way freeway operations. Other features may include the construction of decks over the North and/or South segments of the Loop. Additional lanes are needed on the North and South loop segments to handle existing and future traffic demands. These additional lanes create conflicts with the existing access points serving the Central Business District (CBD), and may cause access restrictions. In addition, the impacts on the existing freeway system operations during construction may be higher due to the need for reconfiguration of highway interchanges.

Land Use Issues:

- Impacts to land uses adjacent to the East and West loop segments may be lower due to the use of all lanes headed in one direction with opportunities for increased number of access points.

- Impacts to existing land uses adjacent to the North and South segments of the loop may be high due to the need for additional freeway lanes and width requirements, thus restricting the assemblage of larger development parcels in these areas. This concept would have a significant impact on the existing freeway system operations during construction due to the need for reconfiguration of all highway interchanges connecting to the Loop.

- The East loop CBD access is supported through the one-way pairs using Charlotte and Harrison, but additional access points along this segment may be possible due to the one-way configuration of the loop.

- Due to the one-way northbound direction of the East segment of the loop, southbound traffic on I-29 headed to destinations south and east of Downtown appears to shift to Paseo. This potential increase in traffic may drive the need for more mixed-uses along the Paseo and result in less residential development in the area.

- Land acquisition and construction of the ramps connecting U.S. 169 to the Northeast corner of the Loop will create a significant negative impact to existing land uses in the immediate vicinity. Recent City initiatives to enhance the Broadway Corridor create a precedent for high quality urban planning and aesthetic treatments to be incorporated in the design of these improvements to support future redevelopment of the area.

- Along the South Loop, the CBD area may require access reconfiguration due to additional lane needs. There may be a need to eliminate the Wyandotte access point from I-670 Eastbound under an expanded Bartle Hall. (This would occur under all scenarios analyzed.)

- Finally, connectivity between the Downtown and Crossroads areas could be made by decking over I-70 with open space and/or commercial development above.

Design Concept No. 2 – Full One-Way Loop

This concept includes the full conversion of the Loop to one-way freeway operations. Other features may include the construction of decks over the north and/or south legs of the Loop.

Land Use Issues:

- This concept impacts land uses in a much different way than all of the other alternatives. The intent is to provide CBD access around the loop to the greatest extent possible. The notion is that the loop would function like a roundabout, but on a much larger scale. This concept would however, have a significant impact on the existing freeway system operations during construction due to the need for reconfiguration of all highway interchanges connecting to the Loop.

- Impacts to land uses adjacent to the all segments of the Loop may be lower due to utilization of all lanes headed in one direction and the ability to provide numerous points of access to currently undeveloped parcels. Any additional lanes that are needed on individual segments of the Loop to handle traffic demands may be able to be built within existing ROW.

- East and South Loop CBD access would be supported by one-way pairs, but additional access points may be possible due to the one-way Loop configuration.

- Due to the one-way northbound direction of the East segment of the loop, southbound traffic on I-29 headed to destinations south and east of Downtown appears to shift to Paseo. This potential increase in traffic may drive the need for more mixed-uses along the Paseo and result in less residential development in the area.

- Land acquisition and construction of the ramps connecting U.S. 169 to the Northeast corner of the Loop will create a significant negative impact to existing land uses in the immediate vicinity. Recent City initiatives to enhance the Broadway Corridor create a precedent for high quality urban planning and aesthetic treatments to be incorporated in the design of these improvements to support future redevelopment of the area.

- The existing Wyandotte access from I-670 Eastbound on the South segment of the Loop may be eliminated due to the planned Bartle Hall expansion.

- Connectivity between the Downtown and Crossroads areas could be made by decking over I-70 with open space and/or commercial development above.

Design Concept No. 3 – North Boulevard Scenario

This concept includes the conversion of the north leg of the Loop to an arterial parkway with at-grade intersections and/or a potential modern roundabout feature. Other features may include the construction of decks over the south leg of the Loop.

Land Use Issues:

- This concept caused concern about the “loss of the loop”, but had a lot of interest is the notion of connecting the CBD to the River Market area. To accomplish this, the North segment of the Loop is taken out of the freeway system, and is converted to a boulevard (one-way pair) utilizing westbound 5th Street and eastbound 6th Street between the Broadway and Heart of America bridges. This provides multiple new development opportunities. Anticipated mixed-use development opportunities along the new north boulevard can assist in reconnecting Kansas City's Downtown with the River Market area.

- The existing freeway lanes on the north boulevard could become infill revitalization opportunities for new buildings and below grade parking structures.

- Additional lanes are needed on the South and East segments of the loop to handle traffic demands. The addition of these lanes creates conflicts with the existing access points serving the CBD, and may cause access restrictions along with additional impacts.

- Impacts on existing freeway system operations during construction may be moderate due to reconfiguration of approaches leading to and from the new boulevard segment. Impacts to the existing land uses adjacent to the East and South segments of the Loop may be high due to the need for additional freeway lanes and width requirements.

- East Loop CBD access is supported through one-way pairs using Charlotte and Harrison.

- Land acquisition and construction of the ramps connecting U.S. 169 to the Northeast corner of the Loop will create a significant negative impact to existing land uses in the immediate vicinity. Recent City initiatives to enhance the Broadway Corridor create a precedent for high quality urban planning and aesthetic treatments to be incorporated in the design of these improvements to support future redevelopment of the area.

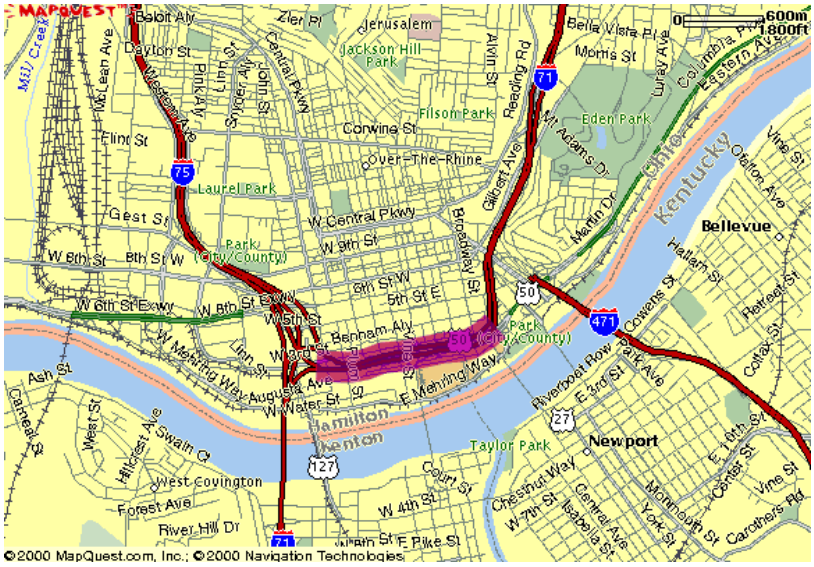
- South Loop CBD area may need access reconfiguration due to additional lane needs. The existing Wyandotte access from I-670 Eastbound on the South segment of the Loop may also be eliminated due to the planned Bartle Hall expansion.

- Connectivity between the Downtown and Crossroads areas could be made by decking over I-70 with open space and/or commercial development above.

2.4 Case Studies

Several projects were reviewed as case studies to gain an understanding of how other communities have dealt with similar transportation and land use issues. The following two examples represent successful integration of the freeway system while continuing to support land use and community development goals:

Case Study Number 1: Fort Washington Way - Interstate 71, Cincinnati, Ohio



Interstate 71 is a sunken freeway, approximately 1-mile in length. Prior to reconstruction, it was unable to safely and efficiently handle the amount of traffic it was carrying. The freeway runs east-west along the southern edge of downtown Cincinnati, disconnecting downtown from the riverfront and sports stadiums.

Previous Condition

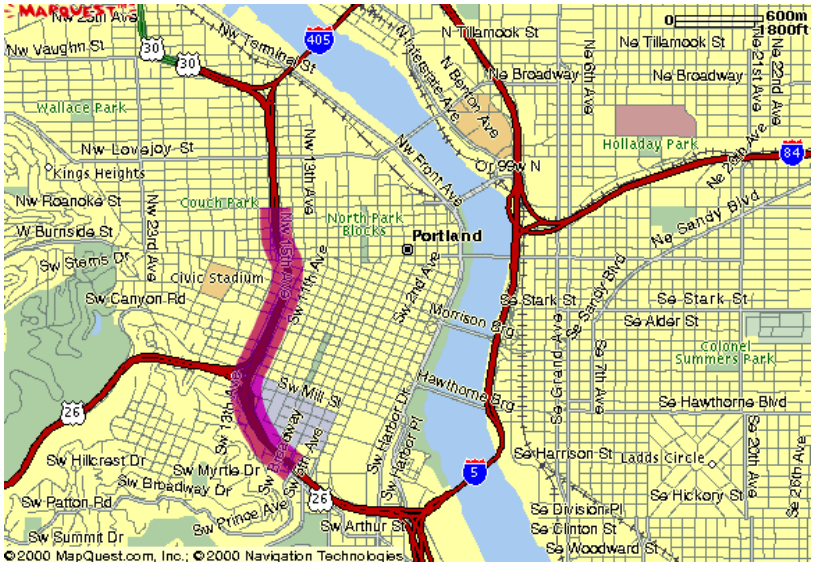
The design goals were to increase the number of through-traffic lanes, reduce the overall highway width by removing interim access ramps, reclaim adjacent land to provide greater flexibility for riverfront redevelopment, and provide safer ingress and egress for downtown and the riverfront area.

Improved Existing Condition

The $314 million project began in 1998 and was completed in 2000. It resulted in improved traffic flow, increased access to the riverfront and downtown, and increased development

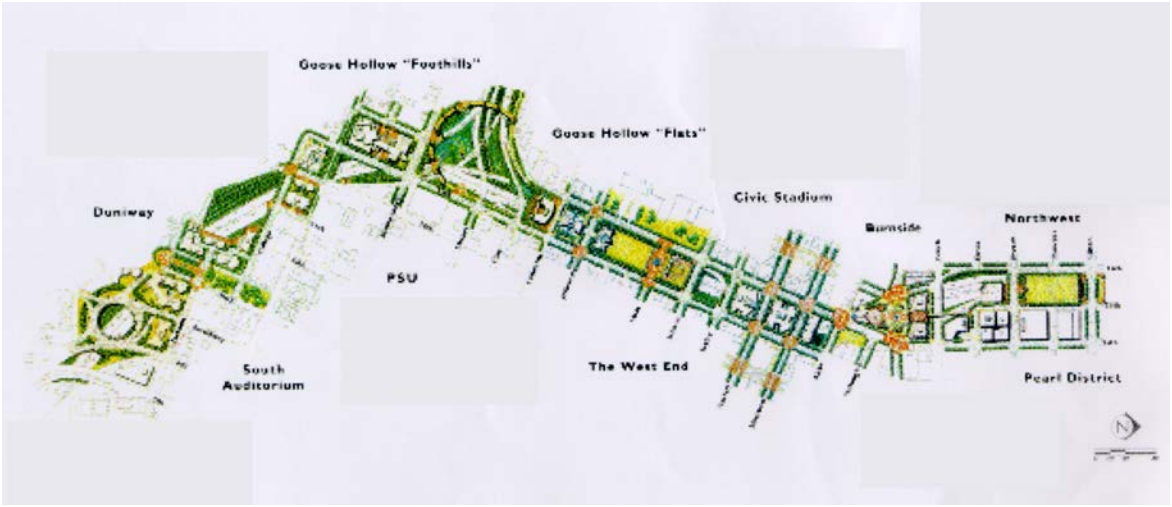
opportunities along the riverfront. Future enhancements may include decking the freeway with parks and plazas.

Case Study Number 2: Interstate 405, Portland, Oregon



Interstate 405 is a sunken freeway that has severed connections between several downtown communities and neighborhoods. It is located in the central portion of downtown Portland, and is approximately 1.5-miles in length. This project is currently in the planning stages.

The primary purpose of the plan is to reconnect eight key neighborhoods of downtown Portland through decks and planned redevelopment over the existing freeway.



Planned Improvement

Access to and from the freeway is planned to be consolidated, resulting in additional land that creates flexibility for a mixture of uses including parks and open space, commercial and residential development, parking, and new civic/exhibition space.

3.0 Traffic Operations Analysis

Traffic operations in the downtown loop were analyzed at a macro-level using the Mid-America Regional Council's regional travel demand model. The analysis is intended to identify the impacts of the Northland~Downtown recommended preferred strategy on the downtown loop as described in the Preferred Strategy Technical Memorandum. The analysis is an initial step toward identifying future improvements to the downtown loop. The results of this work will provide input to the I-70 MIS currently underway.

Traffic operations of the downtown loop were analyzed using two 2020 travel demand scenarios.

Downtown loop impacts in Section 3.1 analyzed:

- "No-Build" Base Scenario
- Modified Base Scenario

Downtown loop design concept impacts in 3.2 analyzed:

- Design Concept No. 1 – Partial One-Way Loop
- Design Concept No. 2 – Full One-Way Loop
- Design Concept No. 3 – North Boulevard Scenario

3.1 Loop Impacts

The following section provides an understanding of how the loop is expected to serve future regional travel demand. This information was used to identify future directional lane needs.

To understand how the region's motorists utilize the downtown loop, a travel market analysis was performed to identify the regional distribution of trips to the CBD. As shown in Table 1, the heaviest vehicle demand is from Jackson County.

Table 1
Travel Markets
2020 Baseline Daily Trips Into the CBD

Market Area	Vehicle Trips	Percent
Northland	21,436	16%
Johnson and Wyandotte Co.	28,516	22%
Jackson County	45,660	35%
Urban Core	34,889	27%
Total	130,501	100%

Future travel distribution within the loop and the future demand (lane requirements) of that distribution are identified as follows:

- **Distribution of Freeway Trips** – The 2020 modeled distribution of freeway trips for each loop approach leg was identified. No-Build (Alternative A) and Partial Roadway (Alternative F) distribution of freeway trips are shown in Figures 2 and 3 respectively.

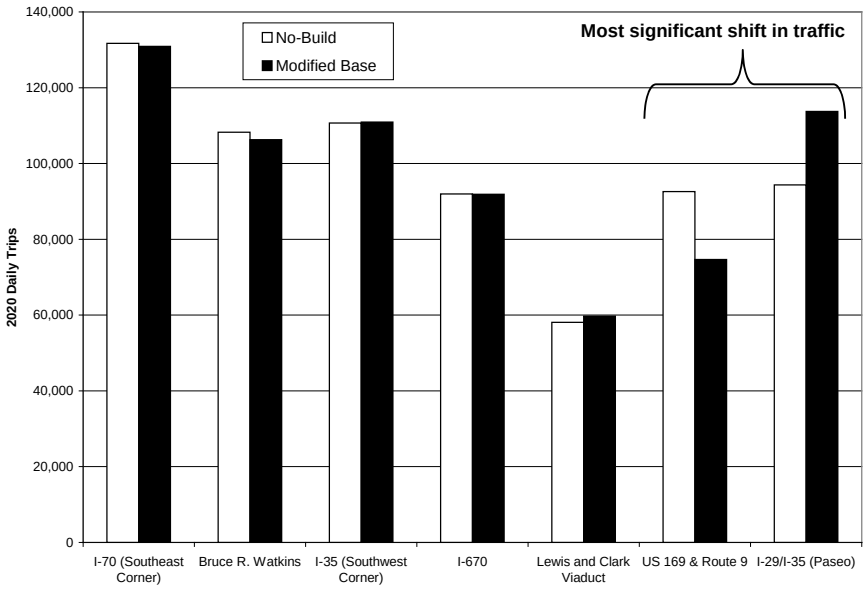
- **Directional Laneage** – The 2020 directional lane requirements on the external approaches based on the directional distribution of freeway trips. No-Build (Alternative A) and Partial Roadway (Alternative F) directional laneage are shown in Figures 4 and 5 respectively.

The **distribution of freeway trips** on loop approach legs can be summarized as follows and shown on Figures 2 and 3:

- Approximately 40% of the total traffic on the downtown loop is destined for the CBD and 60% is through traffic.
- Each approach to the loop carries a different proportion of downtown-oriented and system travel. The greatest imbalance is the I-670 approach, which carries only 23% downtown-oriented traffic versus 77% system through traffic.
- Total traffic demand using the downtown loop is the same between the No-Build and Partial Roadway alternatives. However, there would be a significant redistribution of demand from the Broadway Bridge/Heart of America Bridge corridor pair to the Paseo Bridge corridor. This shift represents approximately 20% reduction in the Broadway Bridge/Heart of America Bridge corridor pair and a 20% increase in the Paseo Bridge corridor.
- Major gate to gate movements for both demand scenarios, as shown in Figures 2 and 2, include:

No-Build (Alternative A)	Modified Base (Alternative F)
- I-670 and I-70 (Double the other pairs) - I-29/I-35 and I-35	- I-670 and I-70 (Double the other pairs) - I-29/I-35 and I-35 - I-29/I-35 and Bruce R. Watkins

- The shift in traffic distribution for downtown loop legs between the No-Build and Modified Base scenarios is shown in the following exhibit. As shown, the greatest shift in traffic is from the US 169 and Route 9 corridor pair to I-29/I-35 corridor.



The **directional laneage** requirements on external approaches can be summarized as follows and shown on Figures 4 and 5:

- Both the "No-Build" Scenario and the Modified Base Scenario would require the same number of total lanes leading into the downtown loop. Improvements in the Modified Base Scenario do not increase demand to the loop but redistribute demand coming into the loop between approaches. (Existing directional lanes = 23, future directional lanes = 27.)

- The Modified Base Scenario does not require more lanes to be built in the downtown loop than the "No-Build" Scenario. The "No-Build" Scenario has a total 2020 daily loop demand of 687,600 vehicles and the Modified Base Scenario has a total 2020 daily loop demand of 688,000 vehicles.

- Both the "No-Build" Scenario and the Modified Base Scenario warrant additional lanes on the same approach legs in 2020. All other approaches would not warrant any additional lanes from current conditions. The approaches that warrant additional lanes include:

    - I-29/I-35, from 2 to 4 approach lanes
    - I-70, from 4 to 5 approach lanes
    - Bruce R. Watkins, from 3 to 4 approach lanes

- Figures 4 and 5 provide a summary of the theoretical lanes needed to serve 2020 downtown-oriented trips versus through trips. As shown, 16 lanes through the Loop would be needed for lane continuity and service to through trips. In addition, 12 direct access lanes into the CBD street system would be needed.

3.2 Loop Design Concept Impacts

Three freeway loop design concepts were analyzed using the regional travel demand model. Alternative design concepts analyzed are shown in Figure 1. The traffic analysis investigated the operational implications of each design concept. Table 2 below shows the future daily traffic demand on each of the four legs of the downtown freeway loop for each of the design concepts.

Table 2
2020 Freeway Loop Comparison
(Daily Traffic Demand)

Road Type	Modified Base ADT	LOOP DESIGN CONCEPTS		
		Partial One-Way Concept ADT	Full One-Way Concept ADT	North Blvd. Concept ADT
Freeway Loop Comparison				
West Leg	67,000	52,600	90,500	61,100
South Leg	149,200	169,200	115,600	190,700
East Leg	131,900	76,600	124,700	151,500
North Leg	102,800	108,100	117,200	31,600
Total	**450,900**	**406,500**	**448,000**	**434,900**
Paseo Boulevard	**31,800**	**43,100**	**45,800**	**34,200**

As shown in the table, traffic demand on each loop leg is affected by the operational changes in the loop configuration. As changes in directional continuity are imposed on the loop, access to destinations are more difficult and require motorists to deviate from a more direct route to alternative streets such as Paseo Boulevard. Design concepts of the Partial One-Way, Full One-Way and the North Boulevard Concepts would all generate increases in motorist vehicle miles of travel (VMT) and vehicle hours of travel (VHT) over the Modified Base Scenario. The Modified Base scenario allows more direct access for motorists to their destinations in the CBD.

Based on the projected demand on each of the freeway loop legs in Table 2, Table 3 provides an estimation of directional lanes needed for each loop leg for each design concept.

Table 3
Freeway to Freeway Loop Lane Continuity

Loop Leg	Description	DIRECTIONAL LANEAGE IN EACH LOOP LEG					
		Existing	Scenarios		Design Concepts		
			"No-Build"	Modified Base	Partial One-Way	Full One-Way	North Boulevard
South	Cross Town	3	5	5	4W / 6E	4	6
North	6th Street	3	3	3	4W / 2E	4	1 (Effective)
East	BRW Extension	3	5	5	4S / 6N	4	6
West	West Freeway	2	3	3	4S / 2N	4	3
Total		11	16	16	16 / 16	16	16

Note: Directional laneage is based on required capacity for system (freeway to freeway) movements thru Loop.

3.3 Traffic Operation Conclusions

Based on the travel demand modeling and traffic operations analysis, a summary of travel and construction impacts was developed. The summary, shown in Table 4, compares the Modified Base scenario with the three design concepts. From the information in the Traffic Operations Analysis Summary (see Table 4) and comments from the Steering and Advisory Committees, the Modified Base scenario was identified as the best overall scenario for the downtown loop from a traffic operations perspective. The Modified Base scenario does not preclude enhancements for improvements to the loop which include decking and other options which do not diminish the integrity of the freeway loop.

Table 4
Traffic Operations Analysis Summary

Evaluation Factor	Modified Base	Concept No. 1 Partial One-Way	Concept No. 2 Full One-Way	Concept No. 3 North Blvd.
	Travel Impacts			
Downtown Trips:				
• Avg. Travel Time (Min.)	NA	Adds 2 to 4 min.	Adds 5 to 7 min.	Adds 3 to 5 min.
• Avg. Travel Distance (Min.)	NA	Increases 5% to 6%	Increases 2% to 3%	Increases 0% to 1%
• North Access Issues	Equal distribution of trips to gateways and access points.	Heavy shift of access to Paseo Blvd.	Heavy shift of access to Paseo Blvd.	Equal distribution of trips to gateways and access points.
• Street Circulation	Lowest CBD traffic demand.	Highest Increase in south side demand.	Highest CBD street traffic demand. CBD streets used for through traffic. Most evenly distributed traffic from all 4 sides.	Decrease in Broadway demand, increase in 12th Street and south side demand.
Trips Into and Through Loop:				
• Travel Patterns	Emphasis on south and east legs of loop.	Reduces overall traffic in loop (10%). Shifts loop travel to other routes.	Fairly equal volumes in each leg (90,000 to 125,000 ADT).	One third travel in north leg. Extra heavy use of south and east legs of loop.
• Loop System	50% to 60% increase in capacity needed.	30% to 40% increase in capacity needed.	50% to 60% increase in capacity needed.	70% to 80% increase in capacity needed.
	Construction Impacts			
• Right-of-way Expansion on loop Sides	Focus on south and east legs.	Greater expansion of south leg than Existing Concept.	Least overall expansion.	Highest with greatest expansion of south and east legs.
• System Interchanges	No conceptual change.	Complete reconstruction and reconfiguration.	Complete reconstruction and reconfiguration.	No conceptual change.
• Maintenance of Traffic	Easiest.	Difficult	Most difficult.	North leg conversion would be difficult.
• Planning-Level Construction Estimates - Access Enhancement for I-29	$30M to $60M	$30M to $60M	$30M to $60M	$30M to $60M

Widening - Loop Scenario Improvements	$270M to $370M	$430M to $640M	$430M to $650M	$550M to $760M

3.4 Highway Lane Continuity

A flyover ramp connecting I-29/I-35 is a preliminary concept to provide better access to the CBD from the Northland. With this concept, direct ramp connections would conceptually connect the northeast corner of the CBD with the freeway system. This would allow motorists to access the CBD prior to the loop. Providing access to the CBD outside of the loop operations improves access to the loop and operations of motorists using the loop for through trips. Ramp connections would be to a frontage road system similar to Truman Road on the south side of the loop. Frontage roads of Charlotte and Harrison would combine to be one-way pair distributors of traffic to the CBD. With the addition of the flyover ramps, access on the eastside of the loop could potentially be consolidated. Direct connections on the south side of the frontage road (southeast corner of the CBD) to the freeway system and Truman Road would also be desirable. A conceptual schematic of the eastside loop improvement is shown in Figure 6. The more detailed traffic operations of the southern end of the Charlotte and Harrison frontage road system would be analyzed in more detail in the I-70 MIS.

Physical impacts to the downtown loop would be a direct result of the Partial Roadway (Alternative F) Scenario, regardless of the loop access improvements. Figure 7 shows the existing lane configuration in the northeast corner of the loop. The proposed Partial Roadway alternative would add two additional lanes approaching and departing the loop at the northeast corner. Two possible scenarios exist to handle these additional lanes. Lane continuity problems could also be fixed without the improvement of the I-29/I-35 connection to the Charlotte and Harrison pair.

- **Add/Drop Lane at Paseo** – Puts more emphasis on Paseo Boulevard by adding and dropping one of the additional lanes across the River. The other lane would come directly into the downtown loop to tie into North Oak. This design concept is shown in Figure 8. This figure does not show the flyover ramp connection to Charlotte/Harrison.

- **Full-Service to/from Loop** – Brings the two additional lanes inbound and outbound from the loop and would be directly connected to the loop. This design concept is shown in Figure 9. This figure does not show the flyover ramp connection to Charlotte/Harrison.

4.0 Recommendation

Based on the land use and traffic operations analysis and input from the Steering and Advisory Committees, improved access into and out of the downtown loop from the I-29/I-35 (northeast corner) leg was identified as a necessary component of the Preferred Strategy for the Northland~Downtown MIS. It was also concluded that the loop improvements should be implemented with the improvement for additional roadway capacity at the Paseo Bridge. Improved access from the I-29/I-35/Paseo Bridge corridor to the CBD is one of the primary outcomes of the loop analysis. More detailed analysis will be necessary and will be performed in subsequent studies. Primary recommendations of this study include:

- The existing two-way traffic operations of the downtown freeway loop is the most efficient configuration.
- Based on study conclusions and input from the Steering and Advisory Committees, with additional freeway lanes penetrating the northeast corner of the downtown loop, improved direct access into downtown would be desirable. This includes conceptual flyover ramps in the northeast corner of the loop, providing direct access from the I-29/I-35 corridor into the CBD connecting to Charlotte and Harrison. This configuration would be desirable only if it were accomplished outside of the immediate loop.
- Along with improved access in the northeast corner of the loop comes the possibility of consolidation of access points on the east leg of the loop to facilitate movement of through trips.
- Roadway improvements would support revitalization efforts for the east side of the CBD.
- Additional freeway lanes will be needed in the loop by 2020 regardless of other regional improvements.
- Consider consolidation of ramp access on north leg with integration of Broadway improvement and deck, like case studies.
- Consider lower level of service for through traffic and provide direct access to CBD-oriented traffic with improved CBD street system.

4.1 Land Use Summary

The improvements identified in Alternate F, coupled with this new direct connection into the CBD using the Charlotte-Harrison one-way pairs (discussed below), would promote and facilitate the continued fulfillment of the established goals of Kansas City's FOCUS plan, as well as land use plans for other communities in the Northland. Other considerations for encouraging and promoting connectivity of the CBD with the Crossroads area via highway decks and with the River Market area via highway decks should continue to be studied in more detail during the I-70 MIS. The proposed visual character of these and other future system improvements should be context-sensitive, and should establish a cohesive vision that guides the urban design and highway aesthetics of the freeway system leading into Downtown and the Loop area. This design approach would support the community's land use and redevelopment goals.

4.2 Traffic Operations Summary

Today, there are locations in the where demand exceeds capacity, lane continuity is inconsistent and multiple access points create undesirable operating conditions. In the future, the Modified Base scenario increases river crossing efficiency by adding capacity to the I-29/I35 corridor. This improvement shifts traffic from the US 169/Route 9 corridor pair to the I-29/I-35 corridor when compared to the No-Build scenario. However, no measurable change in total traffic demand is attracted to the downtown loop as a result of Modified Base improvements. Based on the increased growth of the region through 2020 and existing loop problems -- improved regional access to/from the loop, within the loop and capacity improvements in the loop are necessary. Recommended improvements identified in this technical memorandum will help address existing and future transportation problems with the downtown loop.

Community Involvement

1998 - 2002

1.0 Introduction

A Community Involvement Plan was established early on for the Northland~Downtown Major Investment Study (MIS). The Plan was created using information gathered through a working session of the study team, community interviews, and analysis of existing opinion research. The plan served as a blueprint for guiding activities to inform and involve the public.

The Goals of the Community Involvement Plan included:

- Identify key publics and their concerns
- Effectively inform and involve all publics
- Build support for a preferred alternative

The Northland~Downtown MIS Community Involvement Plan included a list of activities to establish two way communications with the public and study team. The tools that were used to establish these communications involved establishing a mailing list, telephone and mail box, creating a graphic identity, a newsletter, community briefings, public meetings, media relations, and the creation of a Steering and Advisory committee.

The Steering Committee was assembled to serve as the formal decision-making body for the Northland~Downtown MIS. Membership for the committee was based on the policy-level decision-makers within the study area. The Advisory Committee was assembled to surface issues relevant to the study for consideration by the study team and Steering Committee. Membership of the Advisory Committee was based on a broad perspective of persons interested in the Northland. A list of Steering and Advisory Committee members is shown in Appendix A.

2.0 Community Involvement Activities

The following is a summary of the Steering and Advisory Committee activities. Appendix B provides the meeting minutes and agenda from each meeting.

1. **June 3, 1998 Joint Meeting of Steering and Advisory Committee** – First Meeting of Steering and Advisory Group. Kick-off Meeting included a presentation that provided an overview of the major investment study process, detailed the draft goals and schedule for the study, provided information about how the public would be involved in the process, and gave some specific information about the current roadway and transit issues that exist in the study area. An important component of

the presentation included a discussion of the draft study goals and objectives. The goals and objectives were presented to the committees for their review and comment, and will be finalized at the next committee meetings

2. **August 20, 1998 Joint Steering and Advisory Committee Workshop** - The meeting was held in a half-day workshop format and included facilitated discussions of the problems in the study area. Discussion group topics included highway system issues, non-highway system issues, and land use and development issues.

3. **August 21, 1998 Steering Committee Meeting**

4. **Fall/Winter 1998 Newsletter**

5. **March 23, 1999 Advisory Committee Meeting** - The meeting focused on the detailed definition of the initial improvement strategies, and their operational performance.
6. **March 25, 1999 Steering Committee Meeting** - The meeting focused on the detailed definition of the initial improvement strategies, and their operational performance.

7. **May 6, 1999 Advisory Committee Meeting** - The meeting focused on an evaluation of the initial improvement strategies to determine which should be carried forward for more detailed analysis, as well as the study team's recommendations for how to combine the remaining strategies into a group of improvement alternatives.

8. **May 11, 1999 Steering Committee Meeting** - The meeting focused on an evaluation of the initial improvement strategies to determine which should be carried forward for more detailed analysis, as well as the study team's recommendations for how to combine the remaining strategies into a group of improvement alternatives.

9. **October 25, 1999 Advisory Committee Meeting**

10. **April 27, 2000 Joint Steering and Advisory Committee Meeting** - The meeting was held to review and discuss the final set of alternatives, roadway/interchange concepts, and transit operating plans.

11. **August 31, 2000 Joint Steering and Advisory Committee Meeting** - The meeting was held to review and discuss the Central Business Corridor Study, preliminary fixed guideway transit improvement plans.

12. **January 18, 2001 Joint Steering and Advisory Committee Meeting** - The meeting was held to present information on the status of the Central Business Corridor Study and how it impacts this study, extension of the Northland~Downtown MIS scope of services, alignment options for extension of fixed guideway along North Oak Trafficway and to provide a construction cost estimate status report.

13. **May 31, 2001 Joint Steering and Advisory Committee Meeting** - The meeting was held to present traffic demand forecast results, roadway and transit capital costs, review alternative evaluation factors and provide a status report of the downtown loop supplemental work.

14. **June 21, 2001 Joint Steering and Advisory Committee Meeting** - The meeting was held to present preliminary downtown loop information and discuss a preferred strategy based on the alternatives presented at the May 31 meeting.

15. **September 21, 2001 Joint Steering and Advisory Committee Meeting** - The meeting was held to present preliminary downtown loop information and discuss a preferred strategy based on the alternatives presented at the June 21st meeting.

16. **October 16, 2001 Joint Steering and Advisory Committee Meeting** - The goal for the final meeting of the Steering and Advisory committee was to select a preferred investment strategy.

17. **November 13, 2001 Media Press Release** – Northland~Downtown Transportation Study Recommendations Announced through a press release.

18. **May 1, 2002 Project Fact Sheet** – Project fact sheet focussing on the Paseo Bridge Improvement.

NORTHLAND

DOWNTOWN

MAJOR INVESTMENT STUDY

Appendix A

Steering Committee Members
Advisory Committee Members

Table A-1
Steering Committee Member List

Prefix	First Name	Last Name	Title	Organization
Mr.	Mokhtee	Ahmad	Regional Administrator	Federal Transit Administration
Mr.	Dan	Bishop	Mayor	City of Gladstone
Mr.	David	Blackburn	City Administrator	City of Riverside
Mr.	Thomas	Brandom	Presiding Commissioner	Clay County
Mr.	Gene	Bruns	Mayor	City of North Kansas City
Ms.	Betty	Burch	Mayor	City of Riverside
Ms.	Bonnie Sue	Cooper		City Council
Mr.	John	Crawford	Executive Director	Port Authority of Kansas City
Mr.	Paul	Danaher	Councilman, 2nd District	City of Kansas City
Mr.	Dave	Edwards	Planning & Research Engineer	FHWA
Mr.	Ed	Ford	Councilman, 1st District at Large	City of Kansas City
Mr.	Alan	Gray	Government Liaison	Jackson County
Ms.	Betty	Knight	Commissioner	Platte County
Ms.	Teresa	Loar	Councilwoman, 1st District	City of Kansas City
Mr.	Stephen	Mahfood	Director	MDNR
Mr.	Ed	Quick	Missouri State Senator	District 17
Mr.	Dale	Ricks	Assistant District Engineer	MODOT
Ms.	Joni	Roeseler		FTA
Mr.	Harlan	Shaver, Jr.	Mayor	City of Northmoor
Mr.	Bill	Skaggs	Missouri State Representative	District 31
Mr.	Tommy	Thomson	Commissioner	KCATA
Mr.	David	Warm	Executive Director	MARC
Mr.	Russell	Widmar	Director of Aviation	KCMO Department of Aviation

Table A-2
Advisory Committee Member List

Prefix	First Name	Last Name	Title	Organization
Ms.	Carol	Adams		
Ms.	Jane	Beetem	Transporation Coordinator	Missouri Department of Natural Resources
Ms.	Jennifer	Brandt	Chief of Staff	Congresswoman Karen McCarthy's Office
Mr.	Ray	Brock		Curry Investment Company
Mr.	Robert	Bromberg	Assistant to Director	KCMO Department of Public Works
Mr.	Mark	Coulter		Representative from Sam Grave's Office
Mr.	Jay	Dilingham		Northland Betterment Committee
Ms.	Karen	Dolt	Director	United Way of Kansas City
Mr.	Terry	Dopson	Director of Parks & Recreation	KCMO Board of Parks & Recreation
Mr.	Warren	Erdman	Vice President of Corporate	Kansas City Southern RR
Mr.	Larry	Frevert	Assistant Director of Public	City of Kansas City
Mr.	Pete	Fullerton	Executive Director	Platte County EDC
Mr.	Charles	Garney		Northland Betterment Committee
Mr.	Ollie	Gates	Commissioner	KCMO Board of Parks & Recreations
Ms.	Anita	Gorman		Northland Betterment Committee
Mr.	Art	Gough		MARC Bicycle/Pedestrian Transportation
Mr.	Stanley	Harris	City Engineer	KCMO Public Works Department
Mr.	Mell	Henderson	Director of Transportation	MARC
Mr.	Dick	Holwick		KTTR Services, Inc.
Ms.	Lynn	Horsley		The Kansas City Star
Mr.	Bob	Housh	Executive Director	Metropolitan Energy Center
Mr.	Bob	Hurst	Division Chief for City Wide	KCMO Planning & Development
Mr.	Timothy	Kristl		Mitchell, Kristl, Lieber PC
Mr.	Joe	LaMothe	Secretary	Northeast Industrial Association
Mr.	Glen	Leroy		Gould Evans Goodman
Mr.	Pete	Levi	President	The Chamber of Commerce
Ms.	Louise	Lloyd		FTA
Mr.	Tom	McKenna	Director of Marketing	KCMO Aviation Department
Mr.	Ron	McLinden	Environmental Manager	KCMO Department of Enviornmental
Mr.	David	Miller	President	Hilton Flamingo Casino
Mr.	Charles	Myers		Lathrop & Gage
Mr.	Stuart	Nelson	Transportation Planner	MARC
Ms.	Vicki	Noteis	Director	City Planning and Development Department
Mr.	Joe	Perry		KCMO Planning & Development Department
Ms.	Cheryl	Reams	Transportation Coordinator	Missouri Department of Natural Resources
Ms.	Ann	Robertson		Downtown Council
Mr.	Matt	Roney		Representative from Senator Bond's Office
Mr.	Joseph	Rudzik	Staff Writer	Townsend Communications, Inc.
Mr.	Tom	Rule	President	Rule and Company Appraisers
Dr.	Merna	Saliman	President	Maple Woods Community College
Ms.	Karen	Salsbury	Interim Executive Director	Clay County EDC
Mr.	Aaron	Schmidt	Planner	Platte County
Ms.	Yvonne	Seckington	Vice President for market	North Kansas City Hospital

Table A-2
Advisory Committee Member List (Continued)

Prefix	First Name	Last Name	Title	Organization
Ms.	Michele	Shields	CPDC Loan Officer	Clay County EDC
Mr.	Kite	Singleton		E. Chrichton Singleton FAIA, Inc.
Mr.	Curtis	Stock	President	Northland Neighborhoods, Inc.
Ms.	Sheila	Tracy	President	Northland Regional Chamber of Commerce
Mr.	Bob	Watts		MARC Bike/Pedestrian
Mr.	Steve	Wegner	Commissioner	Platte County
Mr.	Roger	Wiebusch	Bridge Administrator	US Coast Guard, DWRO Bridge Branch
Mr.	Bruce	Wiggins	Senior Planner	City Planning and Development
Mr.	Dave	Winslow		Food for Thought
Mr.	Ed	Wolf	Director of Public Works	City of Kansas City
Mr.	John	Wollaston		Valley View State Bank
Ms.	A. Marie	Young	Executive Director	Black Chamber of Commerce
Mr.	Hugh	Zimmer	Chairman	The Zimmer Companies

NORTHLAND

DOWNTOWN

MAJOR INVESTMENT STUDY

Appendix B

Steering and Advisory Committee Meeting Minutes and Agendas

NORTHLAND
DOWNTOWN
MAJOR INVESTMENT STUDY

Bus Transit Improvements
Technical Memorandum

March, 2000

Enclosed are maps and tables showing the following transit alternatives which will be modeled as part of the Northland MIS.

- Alternative 1: No-Build – Transit Base Case
- Alternative 2: Expanded Bus
- Alternative 3: HOV
- Alternative 4: LRT short
- Alternative 5: LRT long
- Alternative 6: LRT short without Southtown LRT

The maps focus on routes in the Northland area. The general operating philosophy which we applied was to provide express service between major production and attraction areas and local commuter service on arterials or other main roads. The inner residential fabric is subdivided into various transit zones and will be served by flexi-routes. The express routes are shown in green where dotted lines reflect limited-access segments. The local or commuter routes are in orange with flexi zones in yellow hatching. (Refer to attached maps for Alternatives 1 through 6.)

South of the river, we assume the long range plan transit network which includes Southtown LRT. In the case of Alternative #6, LRT short without Southtown LRT, we investigated the potential for additional service in the Southtown Corridor, for example, linking to Crown Center and perhaps to Westport and Country Club Plaza. We found that there was more than enough capacity in the current ATA routes to provide frequent connections and sufficient coverage. We have therefore not included extended or new feeder routes and assume the existing bus network will be modeled as part of this alternative.

Bus headways for build alternatives will be modeled at a 50% reduction from the No-Build Alternative. Peak headways are generally 15-minutes for express and 30-minutes for local commuter service, off-peak is 30-minutes. Headways for equivalent routes within various alternatives have been kept constant. In the LRT alternatives the system will initially operate at 10 minute peak and 20 minute off peak. Refer to the attached tables for headways of routes contained in each Alternative.

Services at Transit Centers will be scheduled to timed-transfer (pulse) for the convenience of passengers. Most buses will arrive at the Transit Centers about five minutes prior to their departure time. Under this scenario, transfer times will be five minutes or less for most bus-to-bus transferees. Through passengers aboard most buses stopping at Transit Centers who are not transferring will also experience a five-minute dwell enroute. The exceptions will be line-

haul services (e.g., LRT and express bus routes), which will not dwell enroute. The schedules for the line-haul services will be coordinated with the timed-transfer center pulse in such a way that short connection times (up to five minutes) are ensured for passengers transferring in the predominate direction of travel (to and from downtown Kansas City), but passengers transferring in the opposite will incur connections times roughly equivalent to the full headway of the line-haul service minus five minutes.

Bus operating speeds will be derived from highway speeds. In the case of the LRT we assume speeds 32 mph for interstation links on private right-of-way, 17 miles per hour for the median running segment along Burlington in North Kansas City, 32 mph across the river, then 12 mph through the River Market.

With regard to fare policy for modeling purposes, we assume ATA's present policy would be in effect. A trip on light rail therefore cost the existing base fare ($1.00) and the transfer policy for bus-rail or rail-bus transfers as for bus-bus transfers today. Where transfers are free except for transfers between local to express, which is an additional 20 cents. Express buses will be $1.10 (present fare). Exceptions are: KCI airport express bus from Vivion Station (Short LRT options) are a 20 cent transfer. Direct LRT service KCI Airport Station (Long LRT option) is an additional 20 cents. We have not assumed a fee for parking.

NORTHLAND DOWNTOWN
MAJOR INVESTMENT STUDY

Alternative Alignments from North Oak Trafficway

Two alternative alignments are presented north of North Oak Trafficway. The following description corresponds to the attached map.

Alternative #1

A. The alignment continues north, curves to the west and bridges over SB North Oak Trafficway.
B. Crosses over the future reconfigured off-ramp and I-29 mainline.
C. Station with PNR could be located in this area. The proposed highway plans call for the removal of the I-29 on and off-ramps to/from Vivion Road.
D. Cross Vivion at-grade.
E. Pass under the WB I-29 Bridge using the space in the far north span.
F. Pass under the EB I-29 Bridge using the space in the far north span.
G. Pass under the NB 169 mainline and ramp bridges using the space in the far north span.
H. Pass under the SB 169 mainline and ramp bridges using the space in the far north span.
I. Station with PNR.
J. Bridge structure over I-29. The alignment stays to the north side of mainline and off-ramp at Waukomis.
K. Cross Waukomis at-grade.
L. Station with PNR – Option to continue north along I-29 or Waukomis.

Alternative #2

M. Bridge over ramp to NB 169.
N. Bridge over NB 169
O. Bridge over ramp and SB 169
P. Bridge over ramp to WB I-29

5th Street / 6th Street Flyover Ramps Technical Memorandum

April, 2000

1.0 Introduction

The 5th/6th Street at Broadway Interchange has a history of poor operating conditions. The Northland~Downtown MIS Problem Definition specifically identified the 5th/6th Street intersections as the primary contributor to the reduced capacity and congestion on the Broadway Bridge over the Missouri River. The following technical memorandum identifies the current and future problems at the 5th/6th Street and Broadway Interchange. Design alternatives have been identified to address the problems and traffic analysis was performed to evaluate proposed improvements.

2.0 Problem Identification

Poor service levels, high congestion and long queues have been evident at the 5th/6th Street and Broadway Interchange for a long time. In the mid-1990's, the City of Kansas City, Missouri began investigating short-term improvements. Table 1 shows existing southbound turning volumes coming from the Broadway Bridge. As shown, between 46% and 58% of the peak hour volumes are turning right and are not destined for the central business district via Broadway.

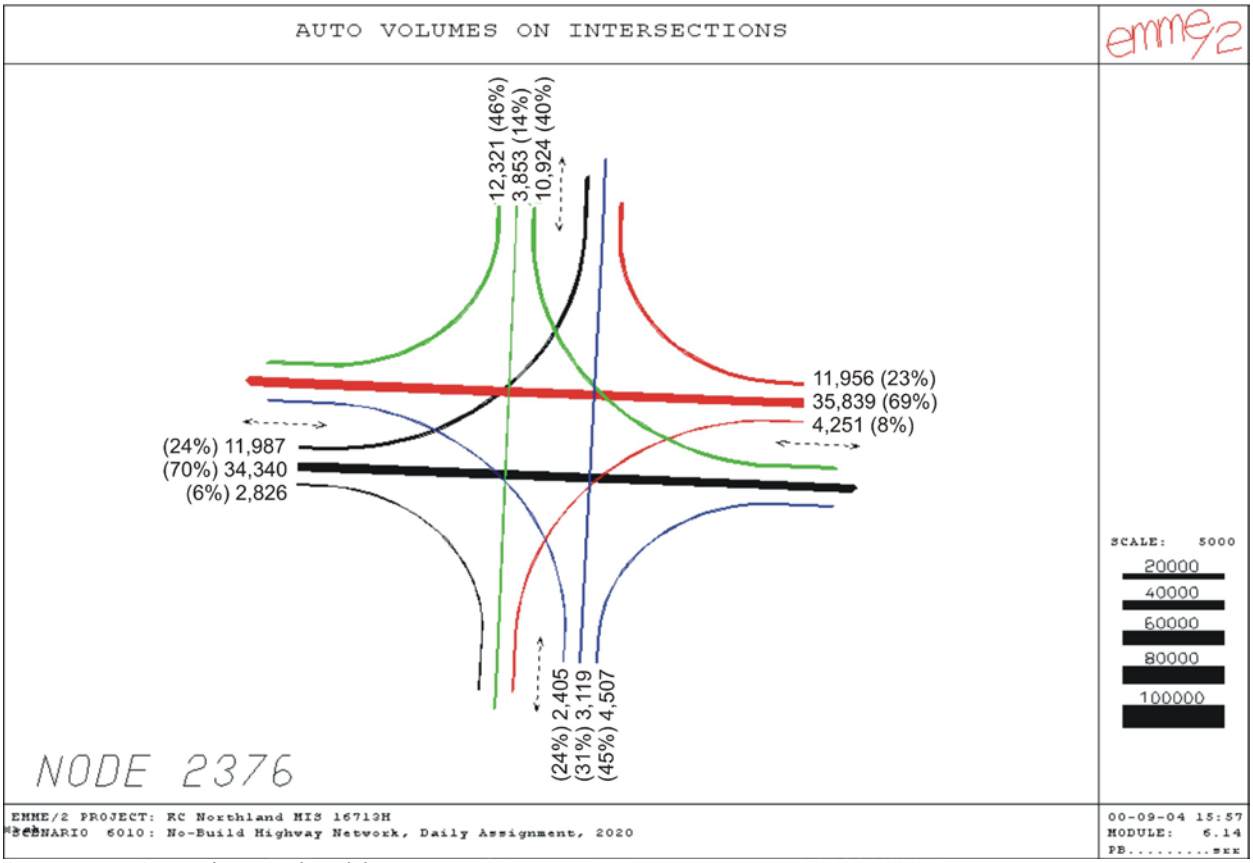
Table 1
Existing Southbound Broadway Bridge Turning Volumes at 5th Street

Period	Southbound Right	Southbound Through	Total
AM Peak Hour	1,218 **(46%)**	1,437 (54%)	2,655 (100%)
PM Peak Hour	707 **(58%)**	502 (42%)	1,209 (100%)
5-Hour Peak	4,146 **(49%)**	4,342 (51%)	8,488 (100%)

Source: 1995 volumes from Kansas City, Missouri Public Works Department

Using the Mid-America Regional Council's (MARC) travel demand model, 2020 turning volumes at the interchange were identified. Figure 1 shows future daily turning volumes. As shown in the figure, 46% of the daily southbound motorists from the Broadway Bridge are expected to turn right to either I-35 or I-70.

Figure 1
5th/6th Street/Freeway Loop and Broadway Interchange
2020 Daily Turning Volumes and Percent
(No-Build Highway Network)



Source: MARC Travel Demand Model

Both existing and future travel patterns show that nearly half of all southbound motorists are not destined for the downtown area via Broadway. By separating these motorists from motorists that are destined for the downtown area, improved operations would be realized for all motorists.

The intersections of 5th/6th Street are the primary bottleneck for Northland motorists crossing the Missouri River on US 169. As a result, the Broadway Bridge can not achieve its full vehicle throughput potential. Intersection congestion at 5th/6th Street contributes to queues on the Broadway Extension that routinely back up past the downtown airport during the morning rush hour.

2.1 Short-term Kansas City, Missouri Improvements

The City of Kansas City, Missouri has been studying the 5th/6th Street at Broadway Interchange since the mid-1990's. Preliminary concepts have focused on providing a short-term improvement to the interchange. Improvements have focused on the following concepts:

- Improve southbound right turn capacity,
- Improve westbound right turn capacity,
- Eliminate access to 4th Street on north leg, and
- Improve signal system.

These improvements are currently in the process of being implemented by the City of Kansas City, Missouri and MoDOT.

2.2 Long-term Improvements

Two design alternative concepts have been identified to address the problems associated with this location. The two design alternative concepts focus on separating Broadway Bridge traffic to/from downtown and to/from the freeway system. Figure 2 provides a free-flow ramp connection between US 169 (Broadway Bridge) and I-35 (West Downtown Loop). Figure 3 provides a free-flow ramp movement from US 169 (Broadway Bridge) into downtown, bypassing the two signals at 5th and 6th Street.

FIGURE 2

5TH / 6TH STREET AT BROADWAY

NORTHLAND DOWNTOWN MAJOR INVESTMENT STUDY

HNTB / PB JOINT VENTURE

FIGURE 3

5TH / 6TH STREET AT BROADWAY

NORTHLAND DOWNTOWN MAJOR INVESTMENT STUDY

HNTB / PB JOINT VENTURE

3.0 Traffic Analysis

Traffic operational analysis was performed comparing the No-Build scenario with Figure 2 design alternative. The No-Build scenario includes the short-term improvements planned by Kansas City, Missouri, discussed in 2.1. Table 2 shows the AM and PM peak hour analysis results.

Table 2
Broadway Flyover Traffic Analysis
2020 Peak Hour

Performance Measures	AM Peak Hour			PM Peak Hour		
	No-Build[1]	With Flyovers[2]	Difference	No-Build[1]	With Flyovers[2]	Difference
System Performance						
Signal Delay / Veh (s)	43	10		105	38	
Total Signal Delay (hr)	165	61		474	259	
Stops / Veh	0.46	0.17		1.02	0.39	
Average Speed (mph)	11	23		4	8	
Total Travel Time (hr)	216	113		518	311	
Fuel Consumed (gal)	264	175		527	340	
Performance Index	229	107		537	308	
Intersection Performance						
5th Street @ Broadway						
LOS	F	D		F	F	
Delay / Veh (s)	131	55		203	132	
6th Street @ Broadway						
LOS	E	C		F	F	
Delay / Veh (s)	65	33		438	236	
Travel Time Performance[1]						
Southbound (s)[3]	515	131	**-384s (-6.4m)**	209	62	**-147s (-2.5m)**
Northbound (s)[3]	278	70	**-208s (-3.5m)**	553	215	**-338s (-5.6m)**
Southbound (s)[4]	544	154	**-390s (-6.5m)**	304	123	**-182s (-3.0m)**
Northbound (s)[4]	121	103	**-18s (-0.3m)**	552	416	**-135s (-2.3m)**

1. The No-Build condition includes Alternative 2 Improvements at the 5th Street Intersection as identified by KC,MO (Alt. 2).
2. Flyovers as they are defined in the Northland MIS (Figure 2).
3. Travel time run from north end of Broadway Bridge to just of west of Broadway Exit on I-35.
4. Travel time run from north end of Broadway Bridge to 7th and Broadway.
5. All analysis performed using Synchro software.
6. The Performance Index (PI) represents a combination of the delays, stops and queuing penalty measures of effectiveness. The lower the PI the better the overall performance of the network.

3.1 System Performance

All system performance measures were significantly improved in both the AM and PM peak hours with the proposed flyover ramp design (Figure 2). Improvements to motorists signal delay, stops per vehicle, average travel speed, total travel time and fuel consumed were improved with the flyover ramps. In the AM peak hour, an overall system performance

improvement of 53% is expected and in the PM peak hour, an overall system performance improvement of 43% is expected in design year 2020.

3.2 Intersection Performance

Intersection level of service and delay to motorists would be significantly improved during the AM peak hour at both 5th and 6th Street intersections. Intersection level of service ratings would improve from an unacceptable rating to an acceptable rating. During the PM peak hour, intersection delay would be improved with the flyover ramps, although an unacceptable level of service still remains.

3.3 Travel Time Performance

Motorists travel times crossing the Missouri River to their destinations are a good measure of how motorists actually experience traveling through this interchange. Two travel runs were analyzed to evaluate this performance during both the 2020 AM and PM peak hours.

1. Travel run from north end of Broadway Bridge to westside of downtown loop.
2. Travel run from north end of Broadway Bridge to 7th and Broadway Intersection.

As shown in Table 2, travel times were improved for every scenario with the flyover ramps versus the No-build scenario. In the peak travel directions, significant improvements to travel time savings are expected. In the southbound direction, during the morning peak hour, more than six minutes of travel time savings is expected for both travel turns to the west side of the downtown loop and 7th and Broadway. During the PM peak hour, significant improvements in travel time were also seen.

4.0 Recommendation

The 5th/6th Street and Broadway Interchange is identified in the Northland~Downtown MIS's Problem Definition as the bottleneck which restricts full capacity of the Broadway Bridge. This location is also a major bottleneck for Broadway corridor operations through the central business district. Since nearly half of the motorists traveling southbound from the Broadway Bridge do not want to continue on Broadway, ultimate solutions that separate these movements from the Interchange would improve the Broadway Bridge capacity and overall motorists operations for all motorists crossing the bridge.

Short-term improvements that Kansas City, Missouri has been investigating should be implemented as soon as possible. These short-term improvements would greatly improve traffic operations at the Interchange. However, the primary problem of under utilization of bridge capacity is not fully addressed with the short-term improvements. Long-term traffic growth projections will need to be addressed with a major improvement such as the flyover ramps between the Broadway Bridge and I-35 on the west side of the downtown loop.

Although Figure 3 was not analyzed at the same level of detail as Figure 2, similar results could be expected. The basic concept of separating out downtown oriented motorists from freeway loop/regional oriented motorists is the same in both figures. More detailed study of the feasibility of the design alternative concepts (Figure 2 or Figure 3) is recommended.